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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 discused. 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 takeninisiative 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 1962when 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.

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:

a) 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;

b) 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:

a) River conservation;
b) River development; and
c) 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 Water-sheds	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 Sualwesi 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

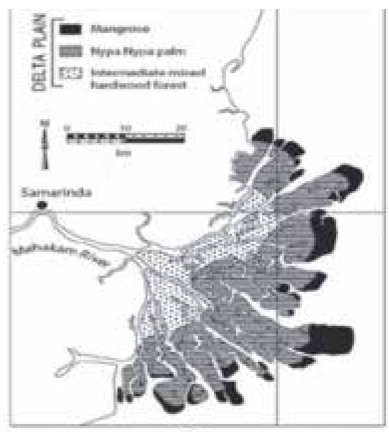
River channels are formed naturally according to the topographical, geological and hydrological conditions of the local area. In their development, demographic, social and cultural influences from the local inhabitants often bring impacts to the rivers' physical condition.

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 rises 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.

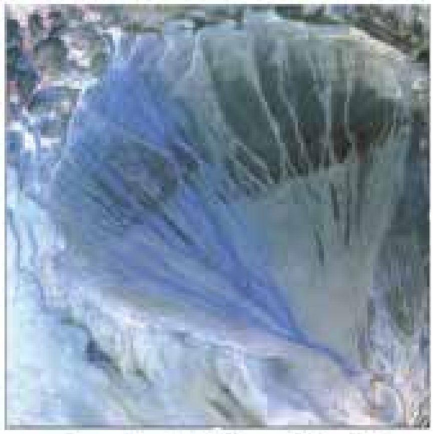
c) Dry Rivers

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.



At the lower part, where the slope is gentle, the speed of flow decreases, causing the flow to lose its carrying capacity and the sediment is deposited in the river channel. When the next mudflow occurs, the river will create a new channel because the old channel is blocked by the previous sediment and is no longer able to maintain the stream. The deposited sediment forms the shape of a fan, therefore the area is called alluvial fan. Since this area is naturally the ideal place to store sediment, this place is usually chosen as the location for sandpockets. The stream in this area often breaks into many branches and is called braided river.

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.

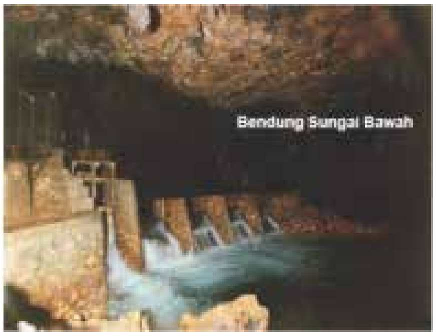


Figure 4: Underground River

Media Indonesia (Tuesday, 4 August 2009) informed that the discharge of the underground river in Bribin reached 1,000 m^3/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 dischage from the land during rainy season because of the covering of land surface and decrease of dischagre 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**

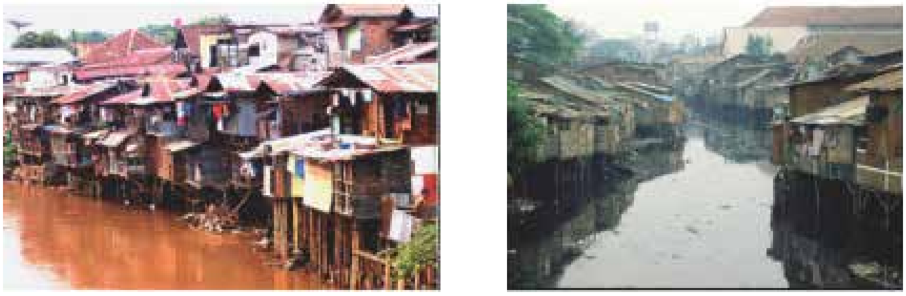


Figure 10: Settlement in the River

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

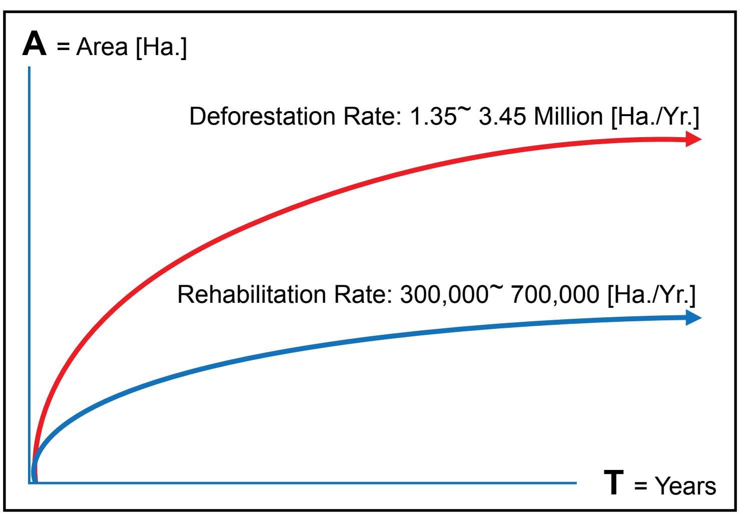


Figure 11: Deforestation and Rehabilitation

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 resultsof 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 BadanPusatStatistik (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.

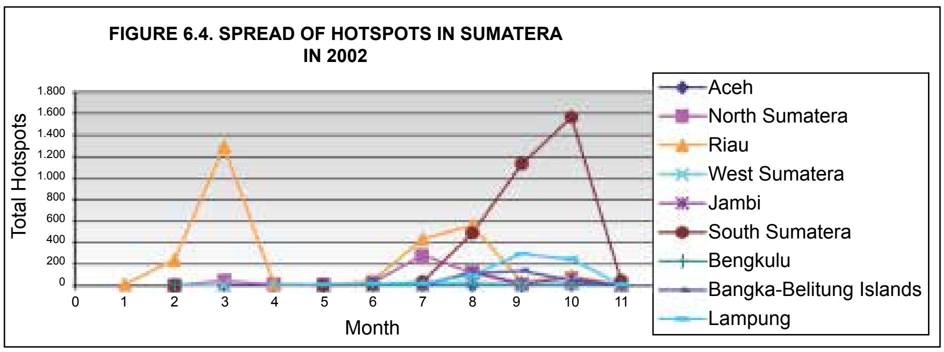


Figure 12: Spread of Hotspots in Sumatera in 2002

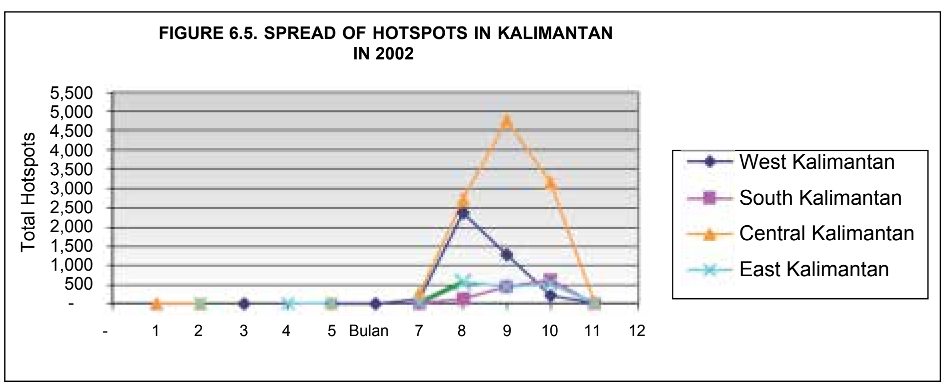


Figure 13: Spread of Hotspots in Kalimantan in 2002
Source: Ministry of Environment, 2002

Figure 14: Forest Clearing
Source: Kompas, 2002

In addition to human factors as described above, deterioration of environment can also be occured 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 thins 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/RegencyGovernments;
(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 goverment 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 costruction 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 establisment 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 Jayabayaof 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 Projek Pentjegahan Bandjir (Kopro Banjir) Djakarta Raja 1964) and the Djatiluhur Multipurpose National Project (Projek 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/ *Embung*	Lombok	Irrigation
29	t.a.d	Gn. Paok Dam/ *Embung*	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	CacabanDam	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	Karangkates Dam	Brantas	Irrigation& Electricity
9	1973	RiamKanan Dam	Barito	Irrigation

Source: *MenyimakBendungan di Indonesia 1910-2006*, KNIBB, 2007 and *BendunganBesar 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 Maatschappi*) 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), whish 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 Karangkates, 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 Karangkates, 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, Bakaru 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 in1969, 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. Thestudy 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). Batutegi 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. Bawakaraeing (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

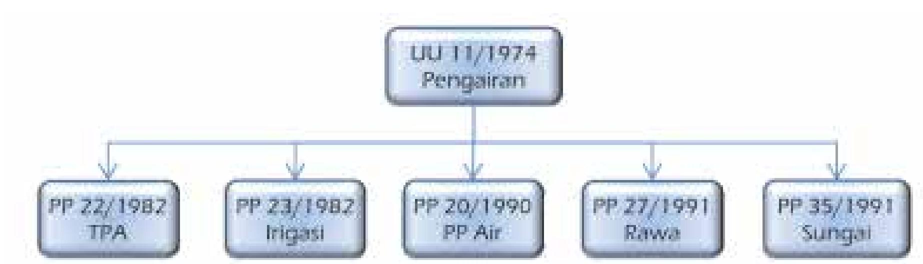


Figure 18: Law Number 11 of 1974 and Its Ancillary Regulations

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 Karangkates
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	Grokgak 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 establih 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 negliglence 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:

a) Improve the empowerment of stakeholders, including effective service and accountability of management institutions, through various activities.

b) Improve the internal empowerment, including the stakeholders, to enhance the performance and effectiveness of institutions development.

c) 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.

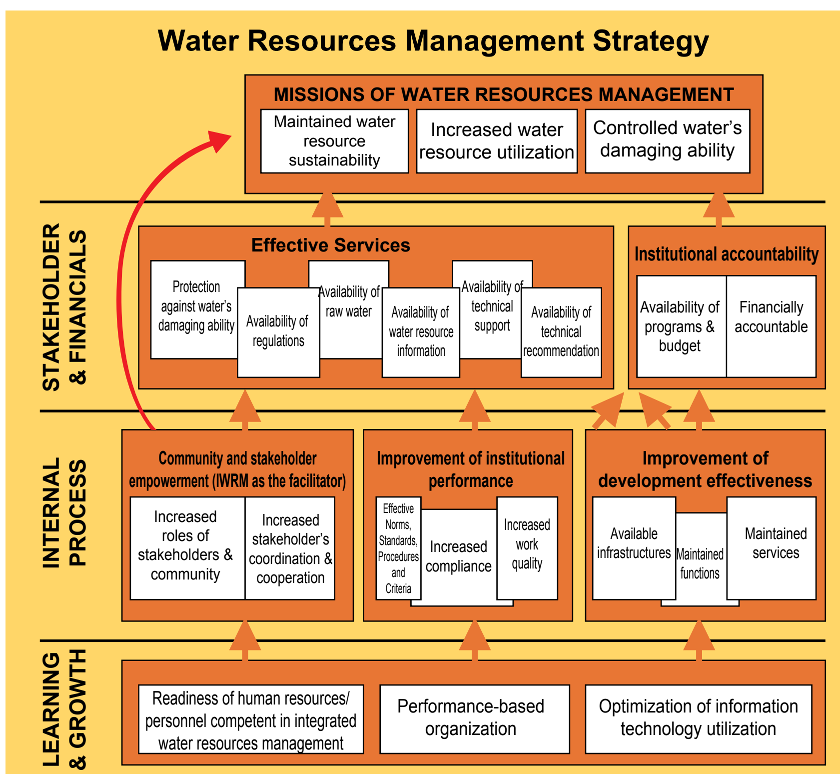


Figure 19: Water Resources Management Strategy

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 aquisition 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 reach10-25 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 (OECF /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	Provice / 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	Batutegi 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	Volcanis 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	Yachiyo 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	Yachiyo 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 Contruction : 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 Jeneberang 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
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 - Konaweha	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	Barumun - Kualuh	2	Panai dan Aek Barumun	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	Reteh	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, Segintung, 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**

LIST OF REFERENCES

A. Laws and Regulations

1.	Law Number 7 of 2004 regarding Water Resources	pdf file
2.	Law Number 24 of 2007 regarding Disaster Management	pdf file
3.	Law Number 26 of 2007 regarding Spatial Planning	pdf file
4	Government Regulation Number 26 of 2008 regarding National Spatial Plan	pdf file
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
10.	Regulation of Minister of Public Works Number 11A of 2006 regarding Criteria and Establishment of River Basins	pdf file
11.	Regulation of Minister of Public Works Number 12 of 2006 regarding Large River Basin Organizations	pdf file
12.	Regulation of Minister of Public Works Number 13 of 2006 regarding River Basin Organizations	pdf file
13.	Regulation of Minister of Public Works Number 23 of 2008 regarding Organizational Structure and Work Procedures of Large River Basin Organizations	pdf file
14.	Decree of Minister of Forestry Number 328 of 2009 regarding Priority Watersheds	pdf file

B. Text Books

1.	*Banjir Kanal Timur*, Roert Adhi Ksp, 2010	hard copy
2.	*Bendungan Besar di Indonesia*, Puslitbang Pengairan (Research and Development Center for Irrigation), 1995	hard copy
3.	*Buku Pintar PU*, 2009	pdf file
4.	*Development of the Brantas River Basin*, JICA, 1998	hard copy
5.	*Ekspedisi Ciliwung*, Gramedia, 2009	hard copy
6.	*Katalog Sungai di Indonesia*, Puslitbang Air (Research and Development Center for Water), 2004	hard copy
7.	*Menyimak Bendungan di Indonesia (1910-2005)*, Radhi Sinaro et al, 2007	hard copy
8.	*Sabo Untuk Penanggulangan Bencana beserta Suplemen*, Yayasan Air Adhi Eka & JICA, 2011	hard copy
9.	*Sabo Untuk Penanggulangan Bencana*, Yayasan Air Adhi Eka & JICA, 2009	hard copy
10.	*Sejarah Embung di Indonesia*, Direktorat Jenderal Sumber Daya Air (Directorate General of Water Resources), 2005	hard copy
11.	*Sejarah Sabo di Indonesia*, Yayasan Air Adhi Eka, Direktorat Jenderal Sumber Daya Air (Directorate General of Water Resources)& JICA, 2005	hard copy
12.	*Sumber Daya Air, Misteri, Sejarah dan Teknologi di Baliknya*, Puslitbang SDA (Research and Development Center for Water Resources), 2006	hard copy

13. *Perkembangan Pembangunan Pengairan di Indonesia*, First Part, Volume 1, Ir. Soebandi Wirosoemarto, Direktorat Jenderal Irigasi (Directorate General of Irrigation), 1997/1998 — hard copy
14. *Perkembangan Pembangunan Pengairan di Indonesia*, Second Part, Volume 3, Ir. Soebandi Wirosoemarto, Direktorat Jenderal Irigasi (Directorate General of Irrigation), 1999/2000 — hard copy
15. *Perkembangan Pembangunan Pengairan di Indonesia*, Third Part, Volume 4, Ir. Soebandi Wirosoemarto, Direktorat Jenderal Irigasi (Directorate General of Irrigation), 1997/1998 — hard copy
16. *Mengendalikan Megalongsoran Gunung Bawakaraeng*, Budiman Haeruddin C. Maddi, PT Sarana Komunikasi Populer, Bogor, 2012 — hard copy

C. Profiles

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-Pompengan	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

D. Reports

1.	*Mengenang Sejarah Irigasi Kerajaan Majapahit*, Kompas, 25 February 2012	pdf file
2	*Kekuatan Pengairan Majapahit*, Nina Susilo & Runik Sri Astuti, Kompas, 26 July 2010	pdf file
3	*Sejarah PU*, website of the Ministry of Public Works www.pu.go.id	pdf file
4	*Prasasti Kamalagyan, Alang alang Kumitir*, Jawa, 16 April 2010	pdf file
5	Japanese ODA to Indonesia	pdf file
6	*Kemitraan Setengah Abad*, Japanese ODA in Indonesia	pdf file
7	*Penyusunan Pola Pengelolaan Wilayah Sungai Jeneberang*, 2012	hard copy

E. Presentation

1.	Collection of presentations on water resource issues	pdf file

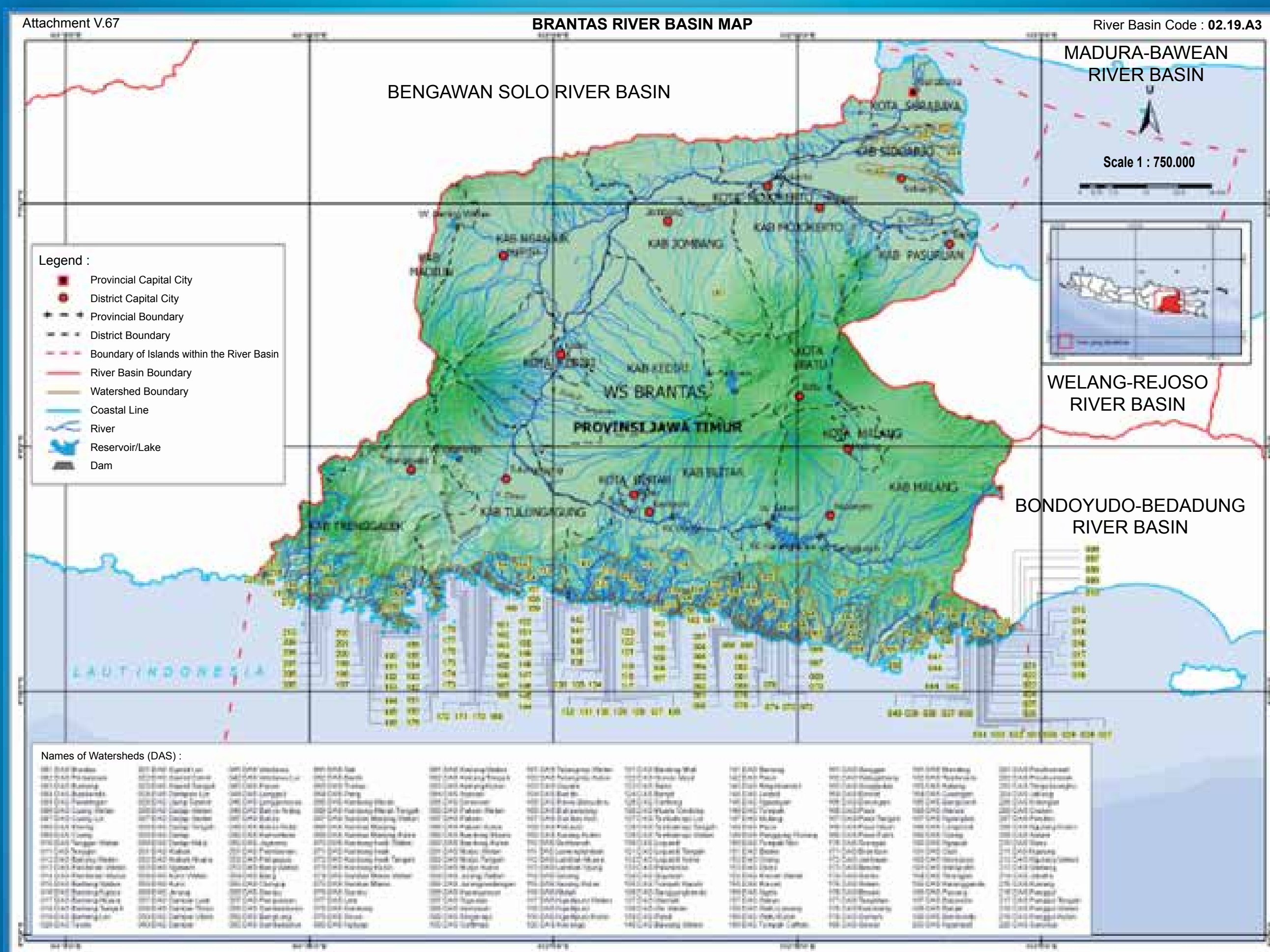
F. Others

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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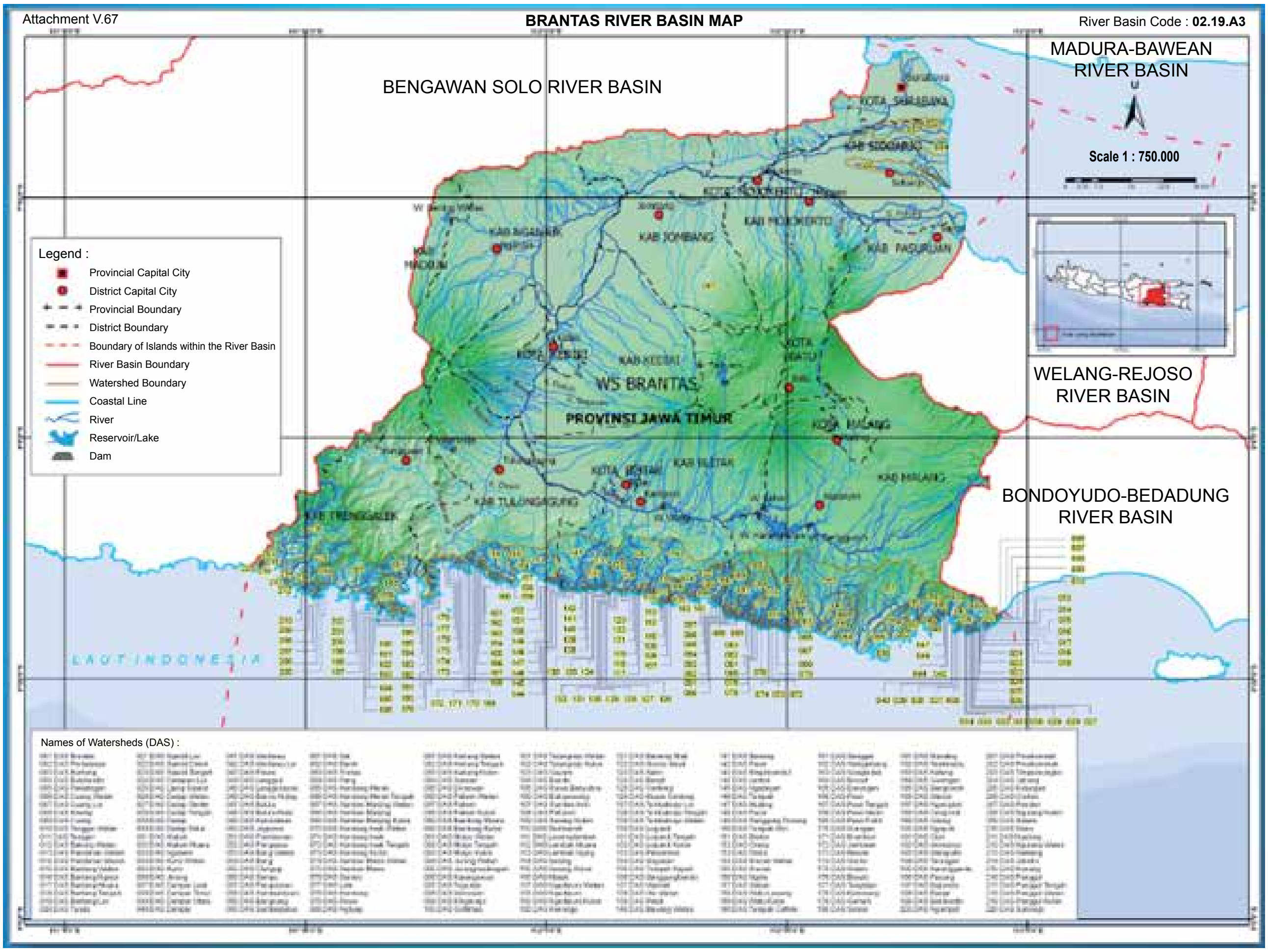


Figure 1: Brantas River Basin

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) Brantasis 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 Grooundwater 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 ± 14,103 km^2 which covers ± 25% of the total area of East Java Province or ± 9% of the total area of Java Island.

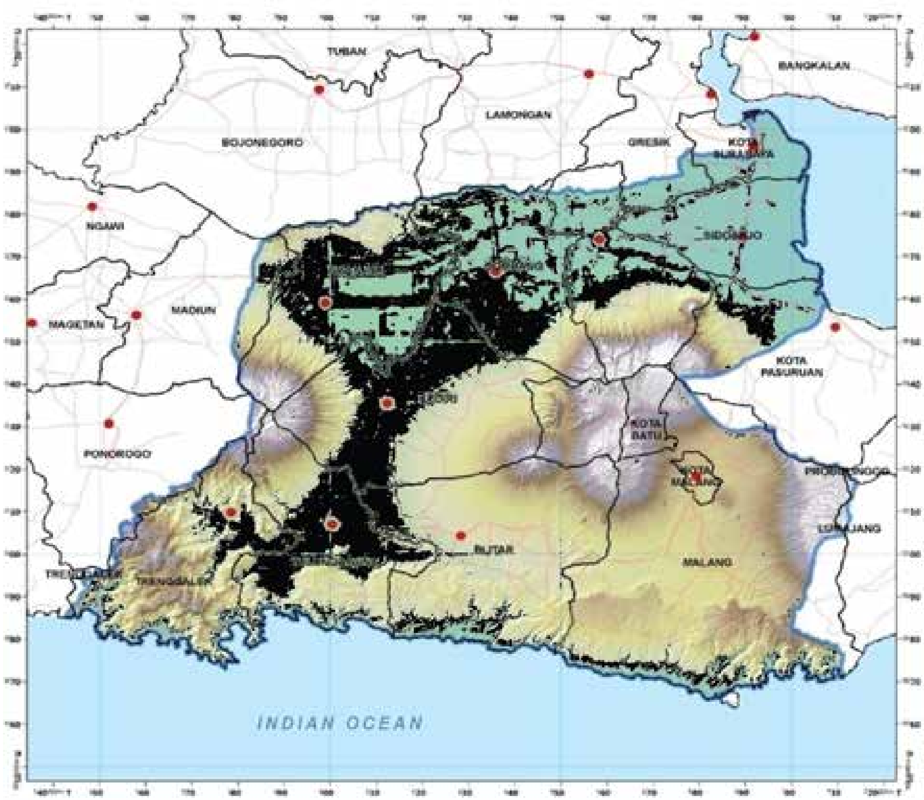


Figure 2 Condition of Brantas River Basin

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 m^3, with utilized amount of around 5-6 billion m^3/year.

The Brantas River Basin consists of the Brantas Watershed, which extends to 11,988 km^2, 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 km^2.

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.

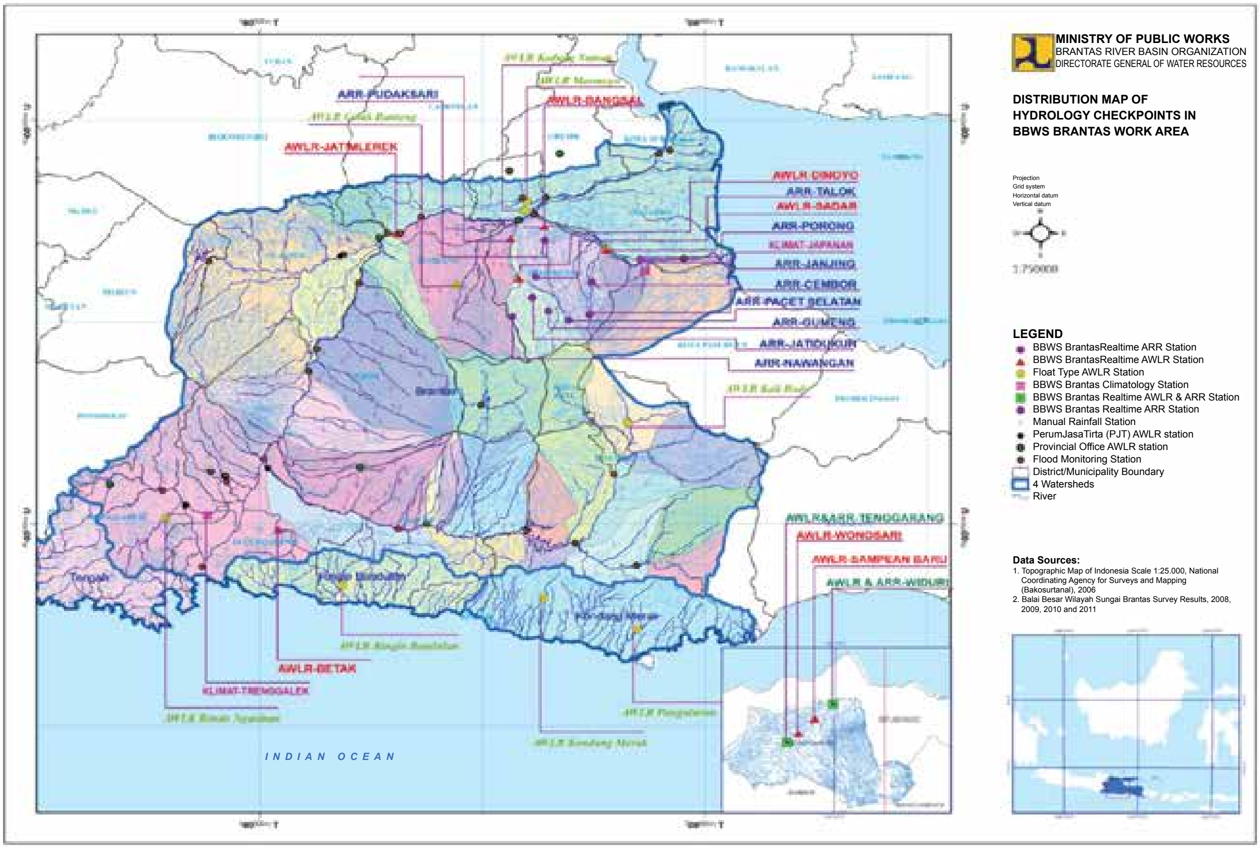


Figure 3: Distribution Map of Hydrology Checkpoints in BBWS Brantas

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 (Km²)
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-infrastructures 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 (/IPAL) 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 fromdamages 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 resourcesin the Brantasriver basinwas originally implementedprimarilyas a meansof flood controlandwater usefor irrigation. The BrantasRiverMasterPlanconsists ofthreestages:

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 ini 1979, Lodoyo dam in 1983, Lodoyo 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:

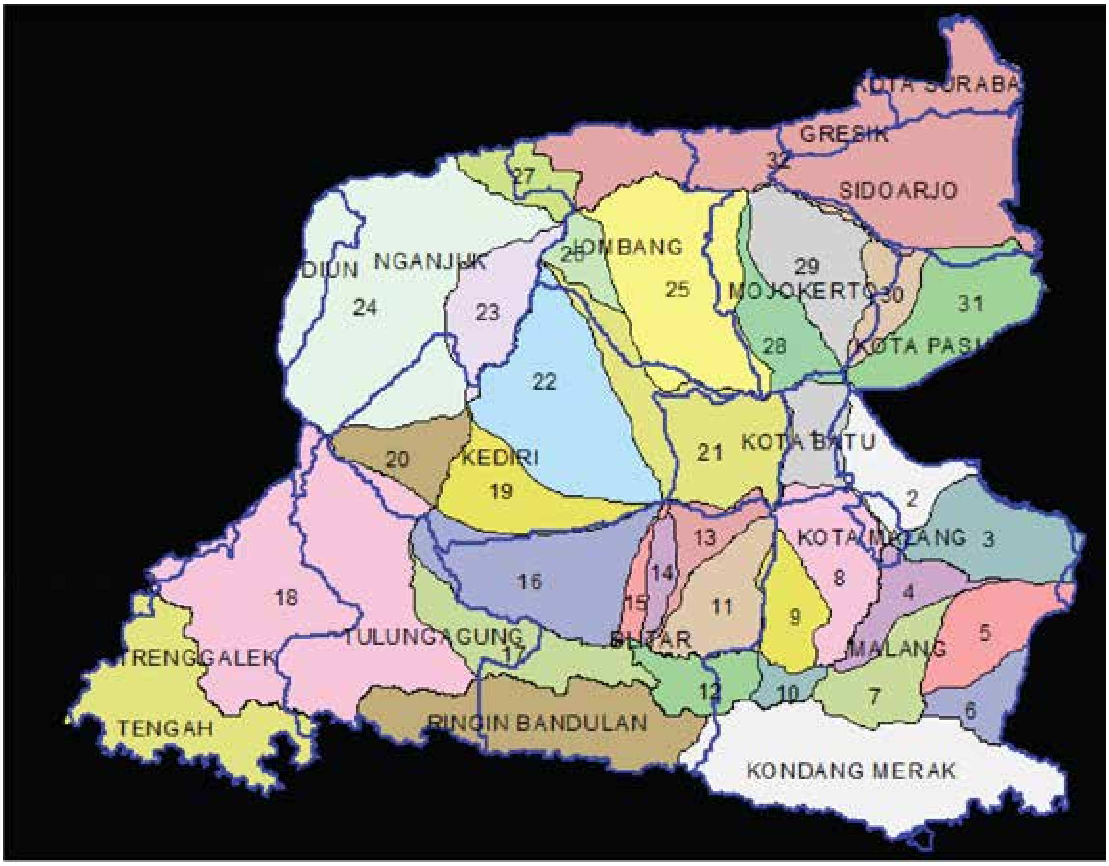


Figure 4: Map of Watersheds in Brantas River Basin

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 movementis 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 donein 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 m^3. The lowest industrial water usage level occurred in 1998, which was 126,52 million m^3.

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 x 10^6 m^3/year
In 2020: 298,803 ha, Water Requirement: 3,765 x 10^6 m^3/year
In 2030: 294,621 ha, Water Requirement: 3,718 x 10^6 m^3/year

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

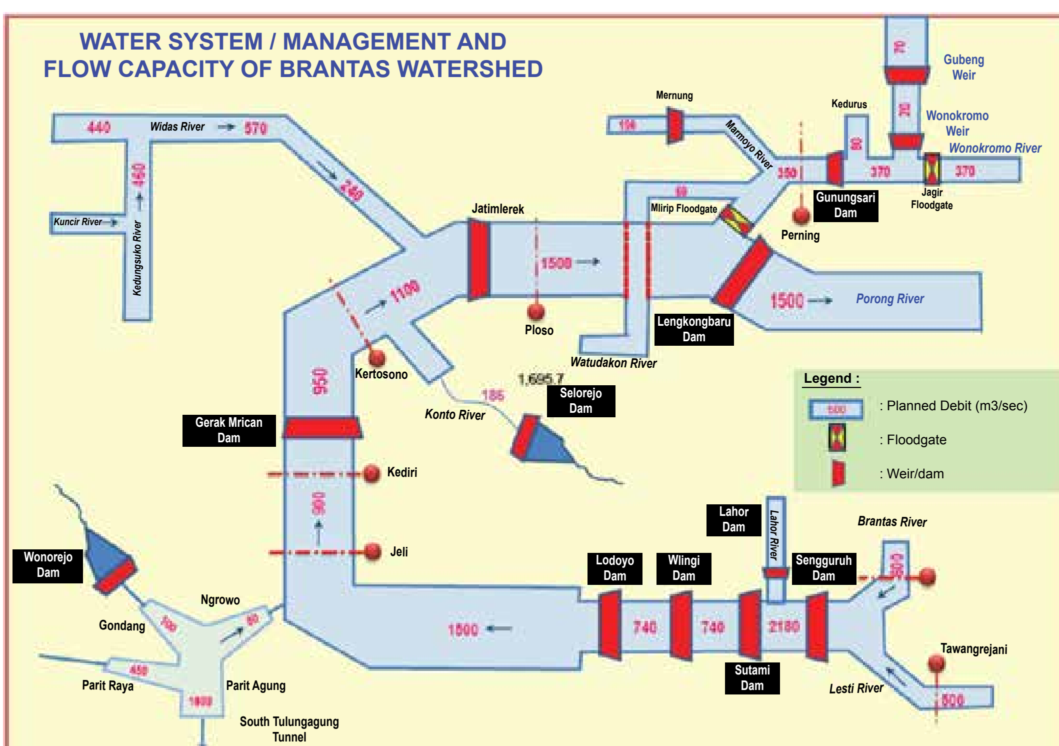


Figure 7: Water System Schematization in Brantas River Basin

- **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 Brantasdoes 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 whichare managed by 3 Contract Executive Officers. Among them are:

- Water Resources Conservation Utilization (PKSDA) *Embung*

Figure 11: Jalas Spring, Kediri Regency

- Raw Water *Embung*

Figure 12: EmbungKlampok 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

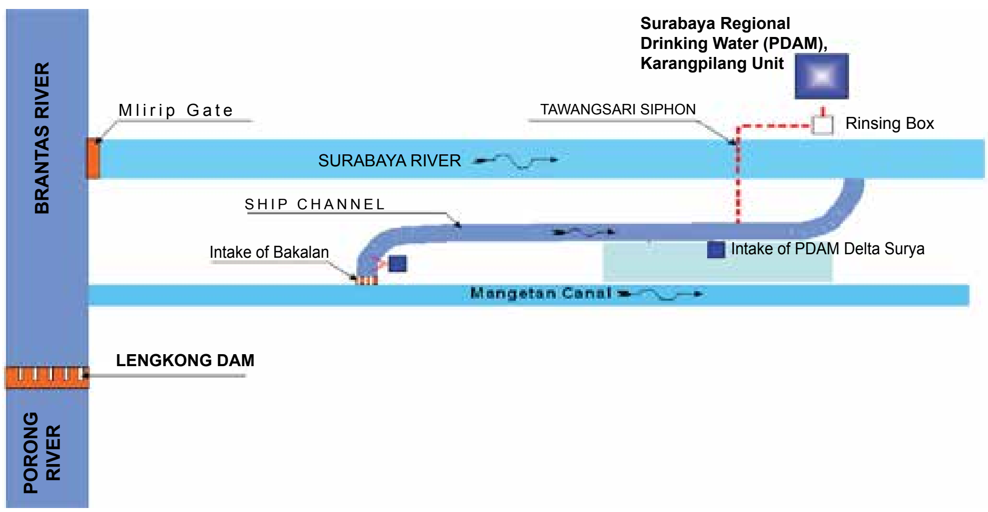


Figure 15: Ship Channel of Surabaya City

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

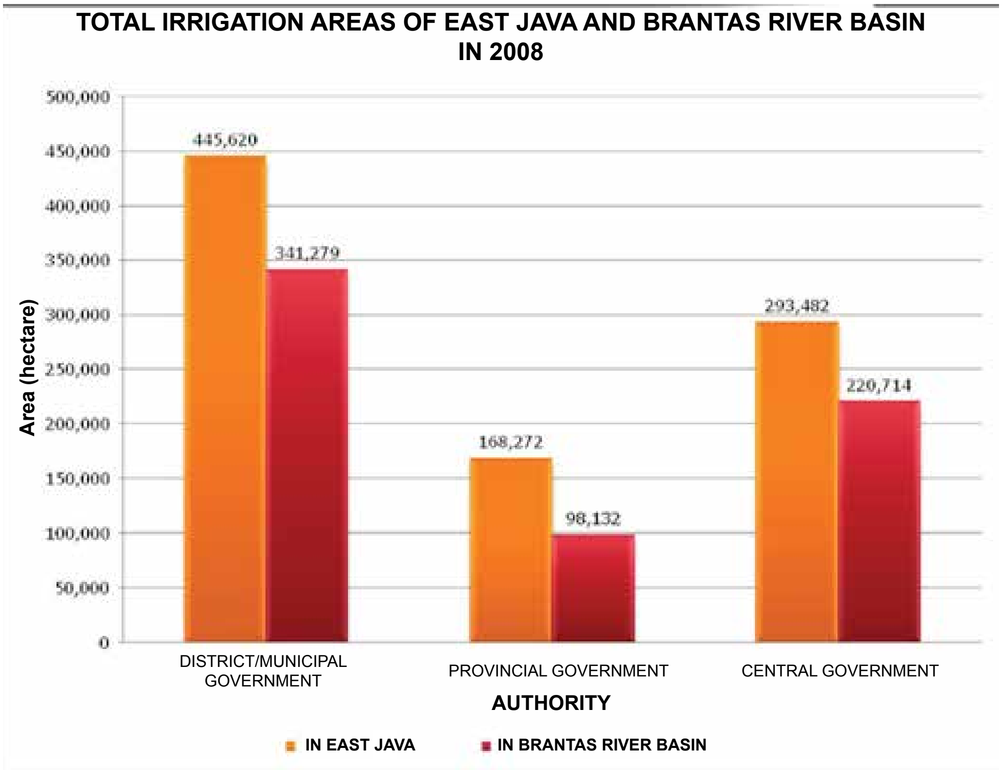


Figure 16: Total Irrigation Areas of East Java and Brantas

Figure 17: Irrigation Infrastructures

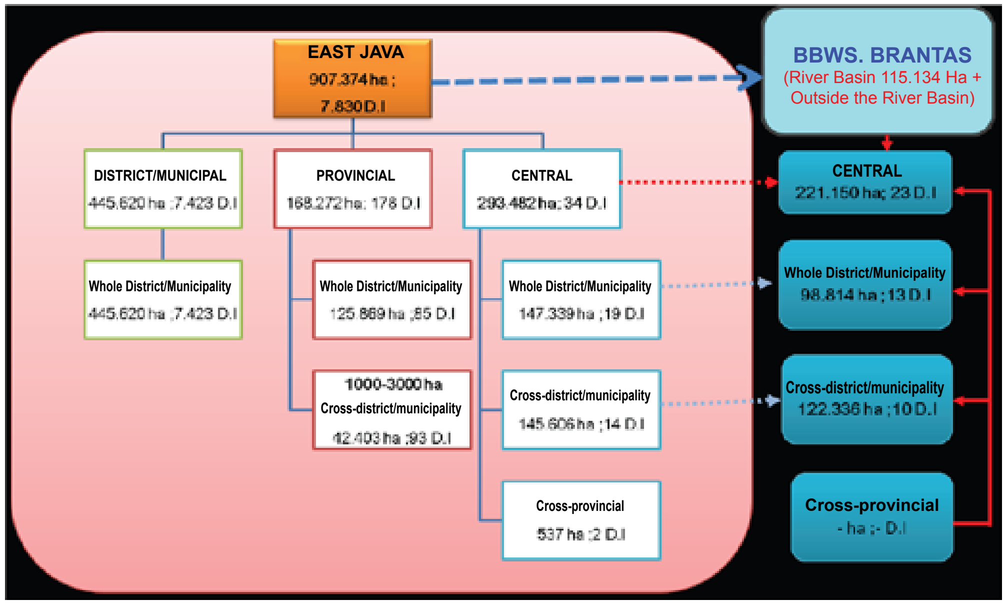


Figure 18: East Java and Brantas Irrigation Tree

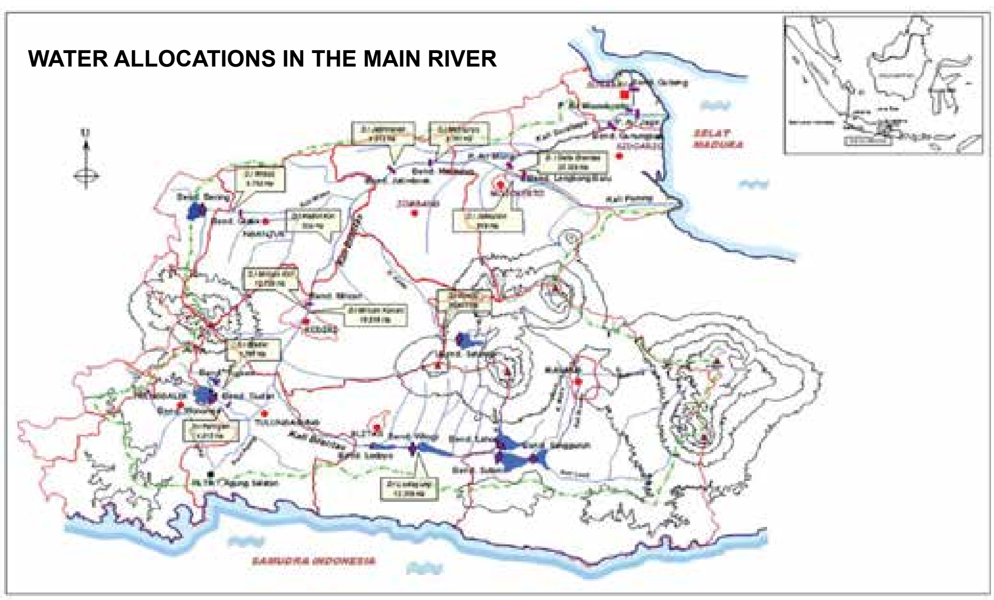


Figure 19: Main River Water Allocation

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 x 10^6 m.

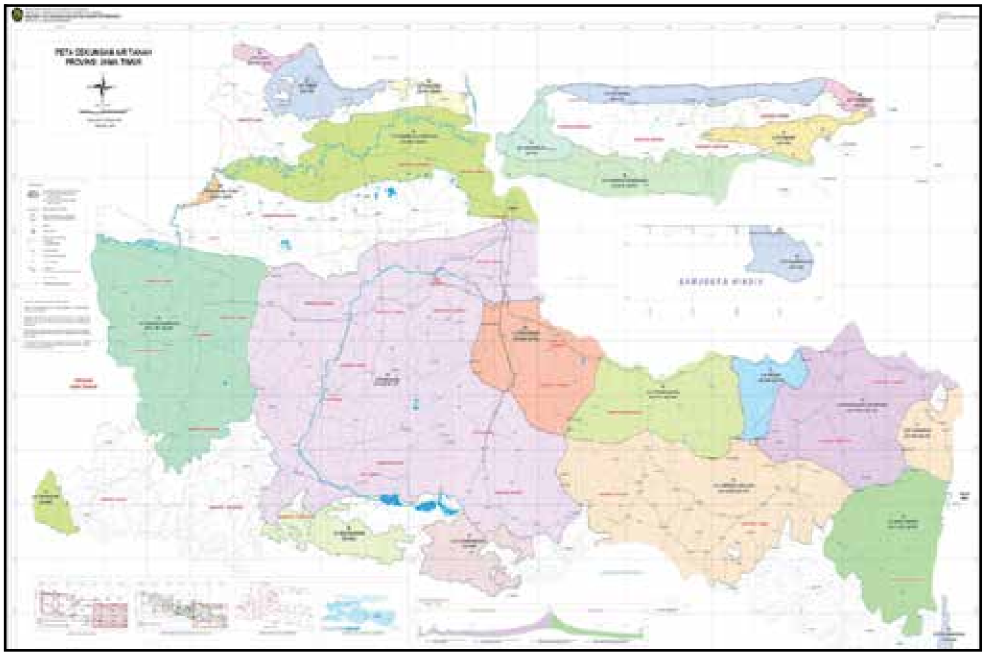


Figure 20: Map of Groundwater in East Java

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 Karangkates Dam, Lahor Dam, Selorejo Dam, Wonorejo Dam, and Bening Dam.

c) In the downstream, the flow of flooding in the riveris passed through the Porong River into the sea through the operation of the Lengkong 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 MasRiver) 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 threat on 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 Karangkates 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

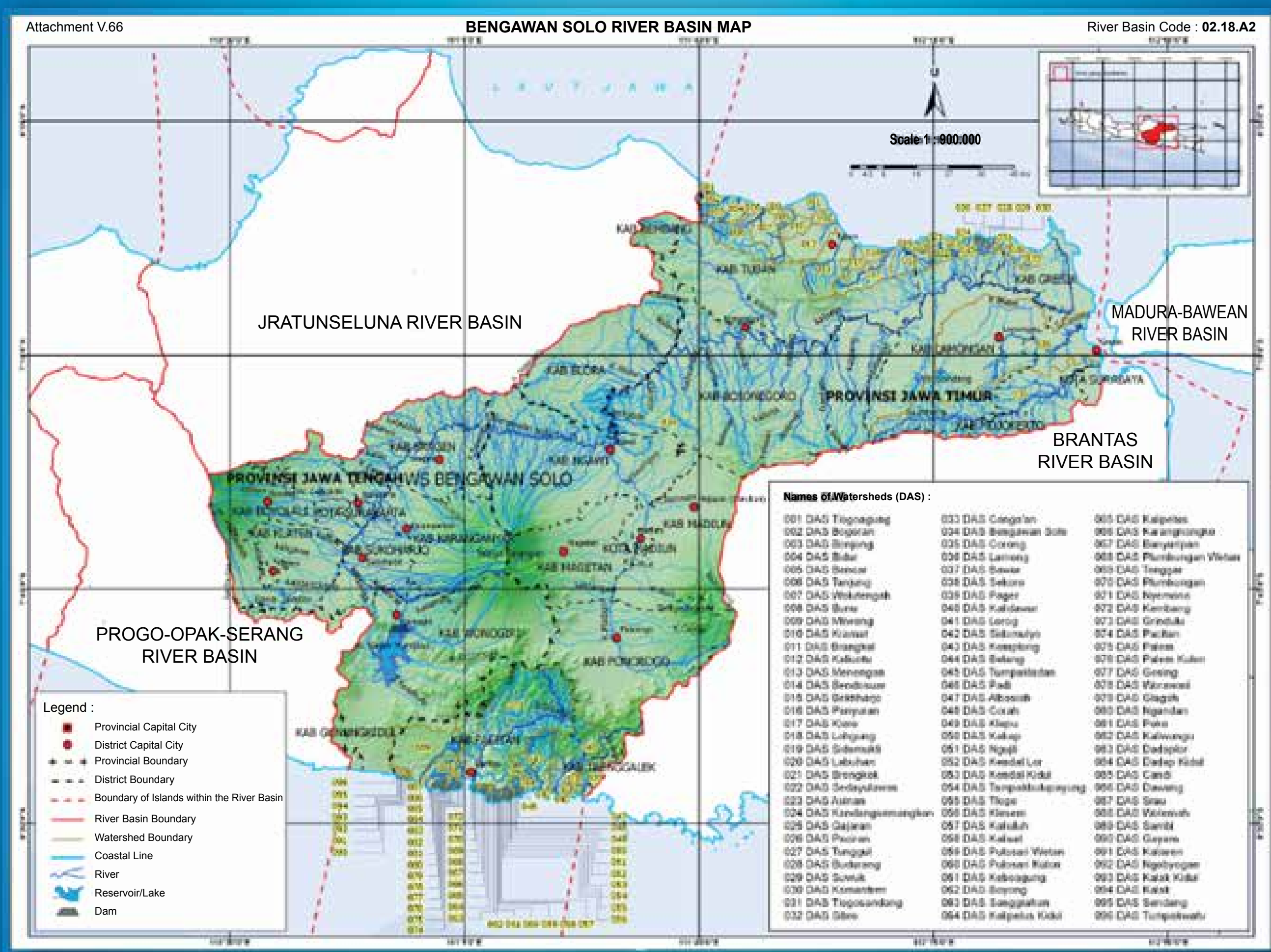
- Conducting monitoring and creating a water resource and flood information system, conducting more comprehensive evaluation and studies for future water resources management with regard to climate changes.

- 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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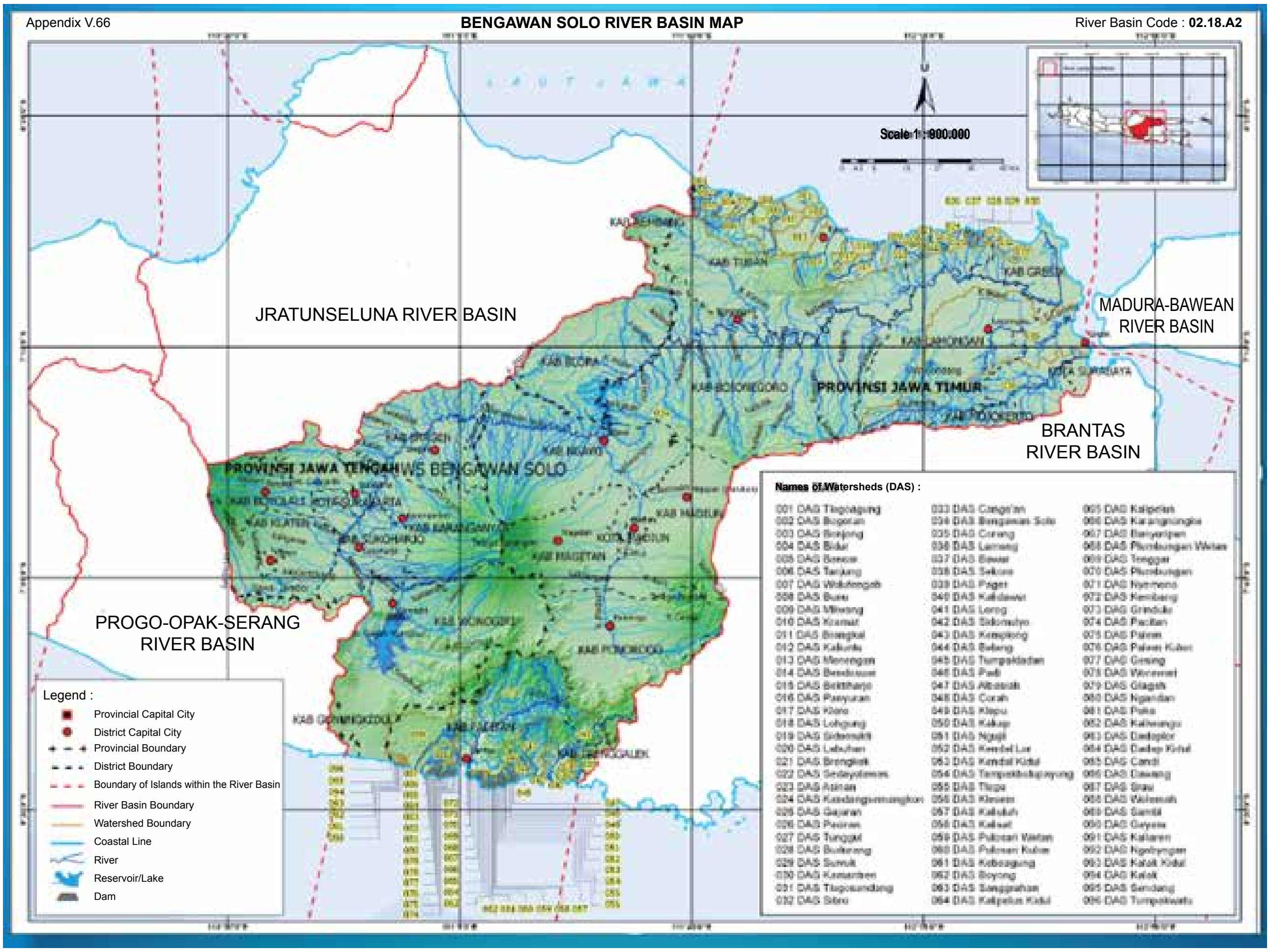


Figure 1: Bengawan Solo River Basin

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.bbwssolo.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 (Km²)
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.

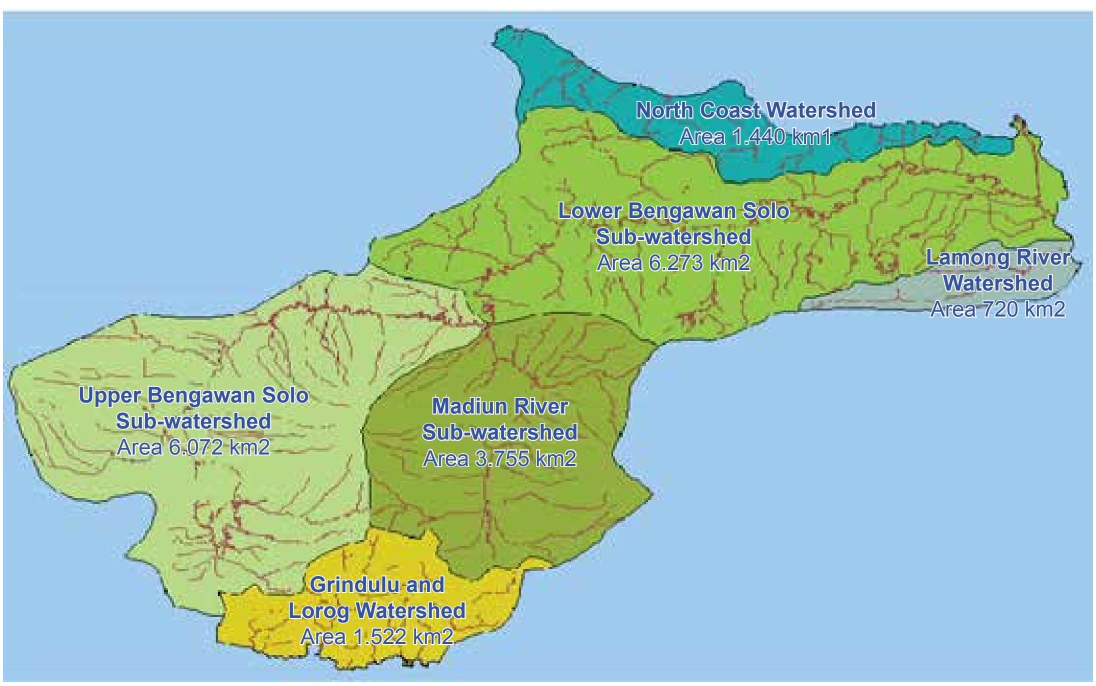


Figure 3: Sub-watersheds in Bengawan Solo

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 ofsediment(Gresik regency) andon 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.

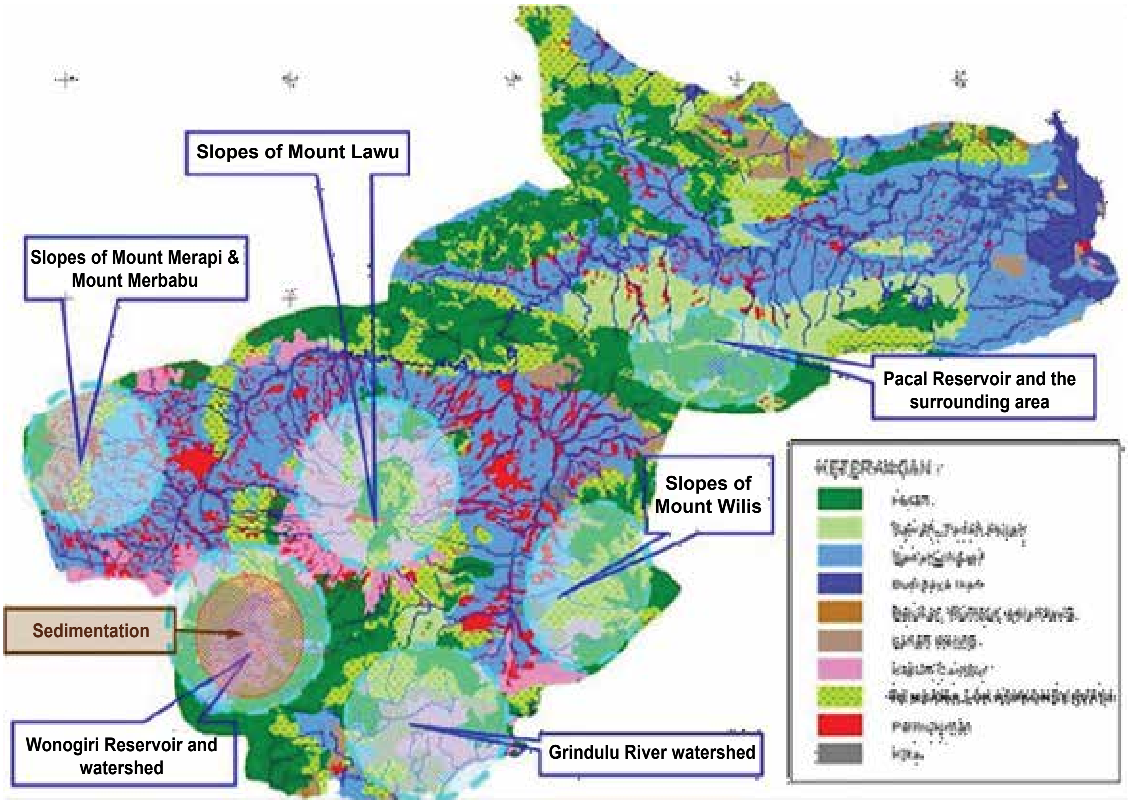


Figure 12: Locations of Run-off Arrangement Program

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.

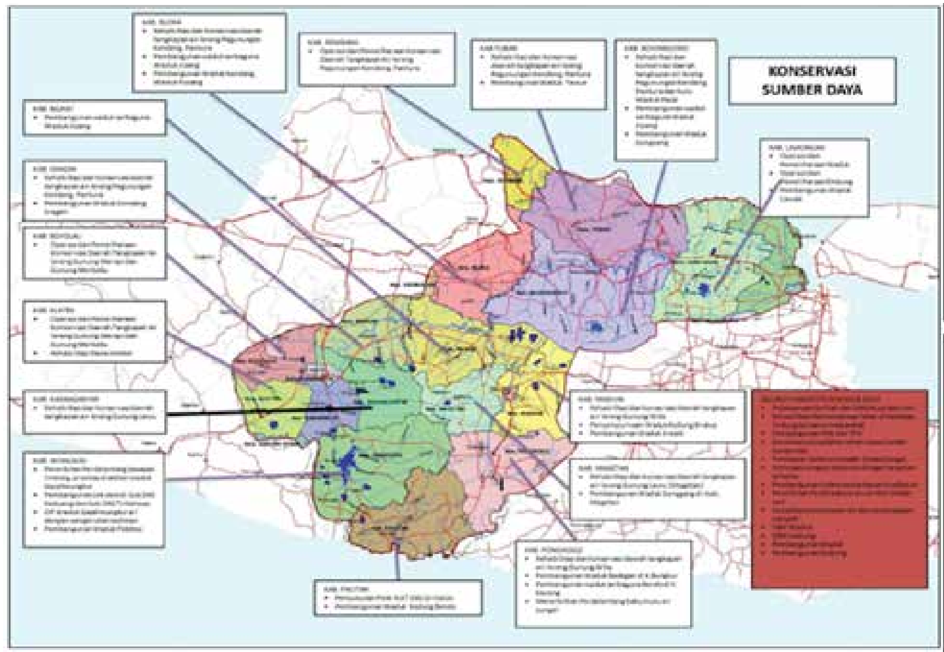


Figure 13: Water Resource Conservation Program

Figure 14: Construction of Sediment Retention Structures

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:

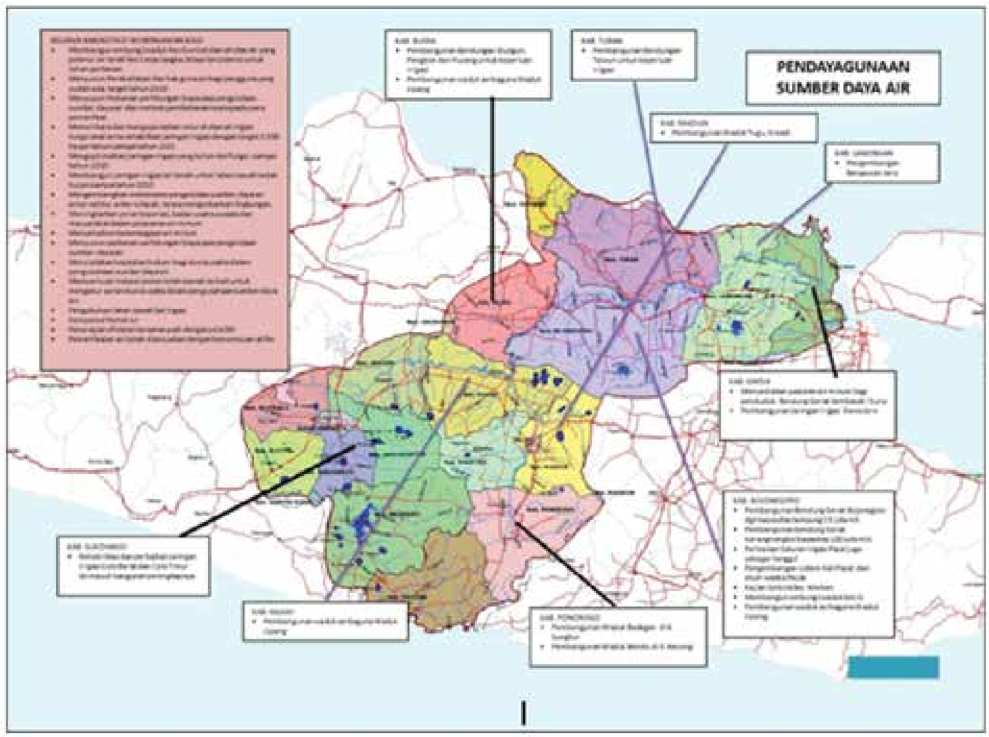


Figure 15: Water Resource Utilization Program

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 toovercome the problem offlooding, 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 ofwater shortage, which is to increase agricultural production, particularly rice, through the construction ofirrigation area extending to 1000ha, to increase the supply of clean/raw water in an amount of 500 millionl/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 HydroPower 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:

a) Dams and *embungs* as presented in Table 10.
b) Barrages (long storage) in Babat with a storage capacity of 30 million m³ and in Bojonegoro with a holding capacity of 13 million m³.
c) Plangwot-Sedayu-Lawas Floodway, which stretches 12.4 km with discharge capacity Q=640m³/second.
d) 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.

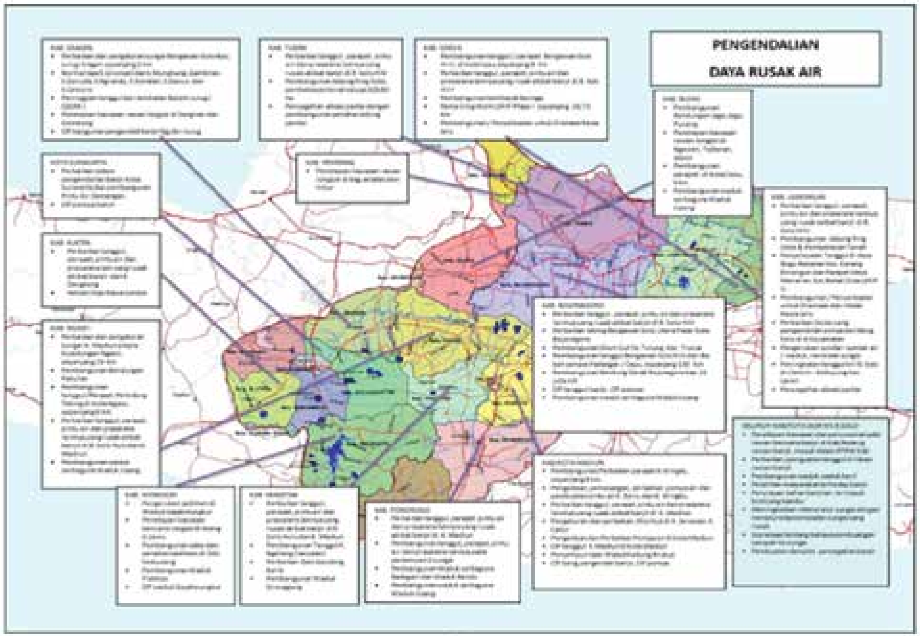


Figure 17: Control of water destructive power Program

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.

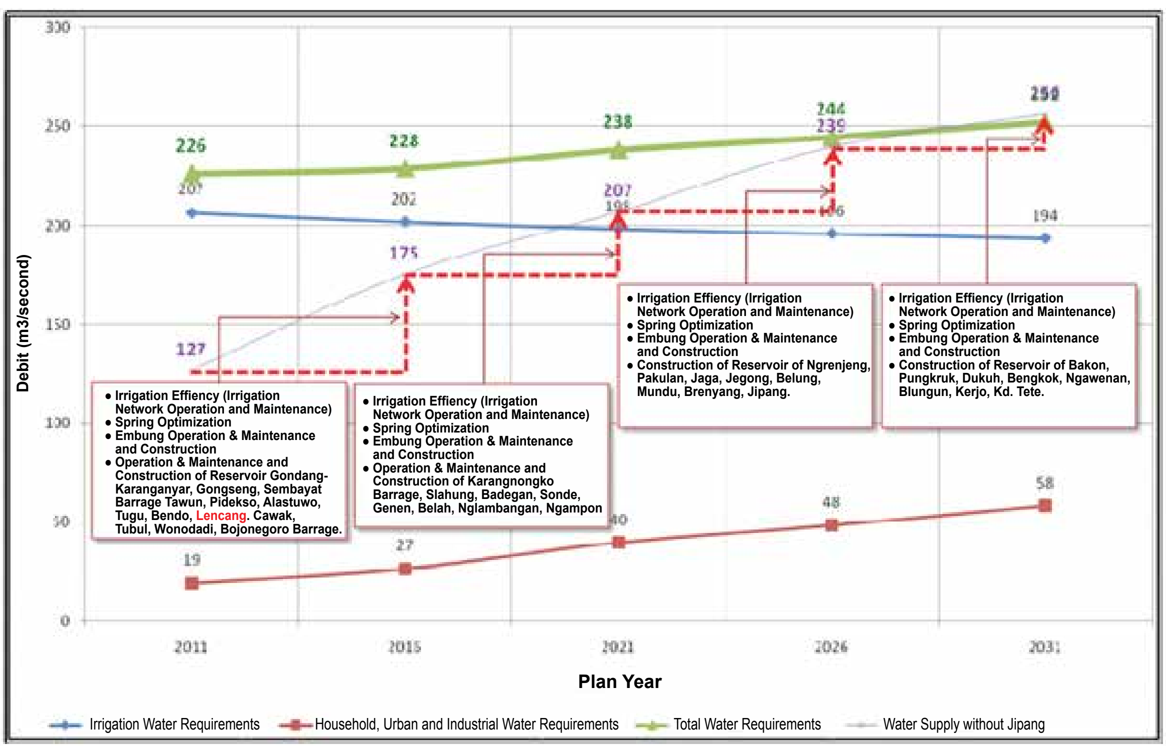


Figure 19: Scenario of Water Requirement Fulfillment by Karangnongko Barrage

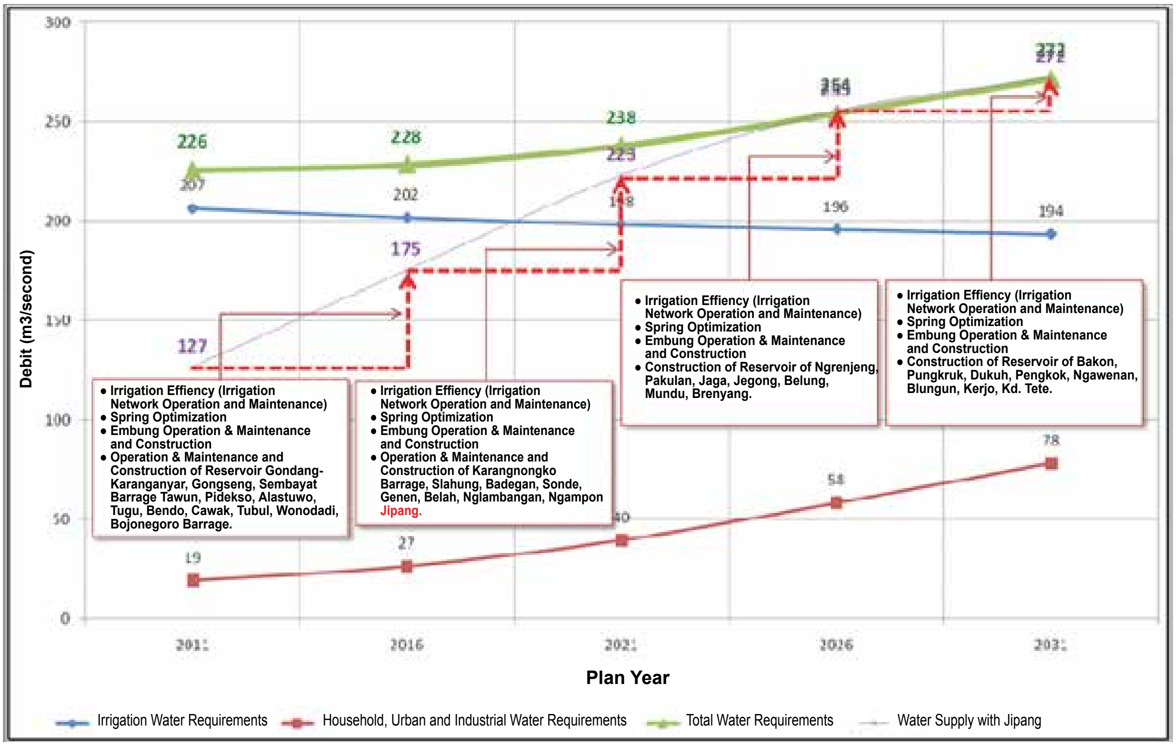


Figure 20: Scenario of Water Requirement Fulfillment by Jipang Reservoir

3.3. Implementation Strategy

To date, the implementation fo CDMP is as follows:

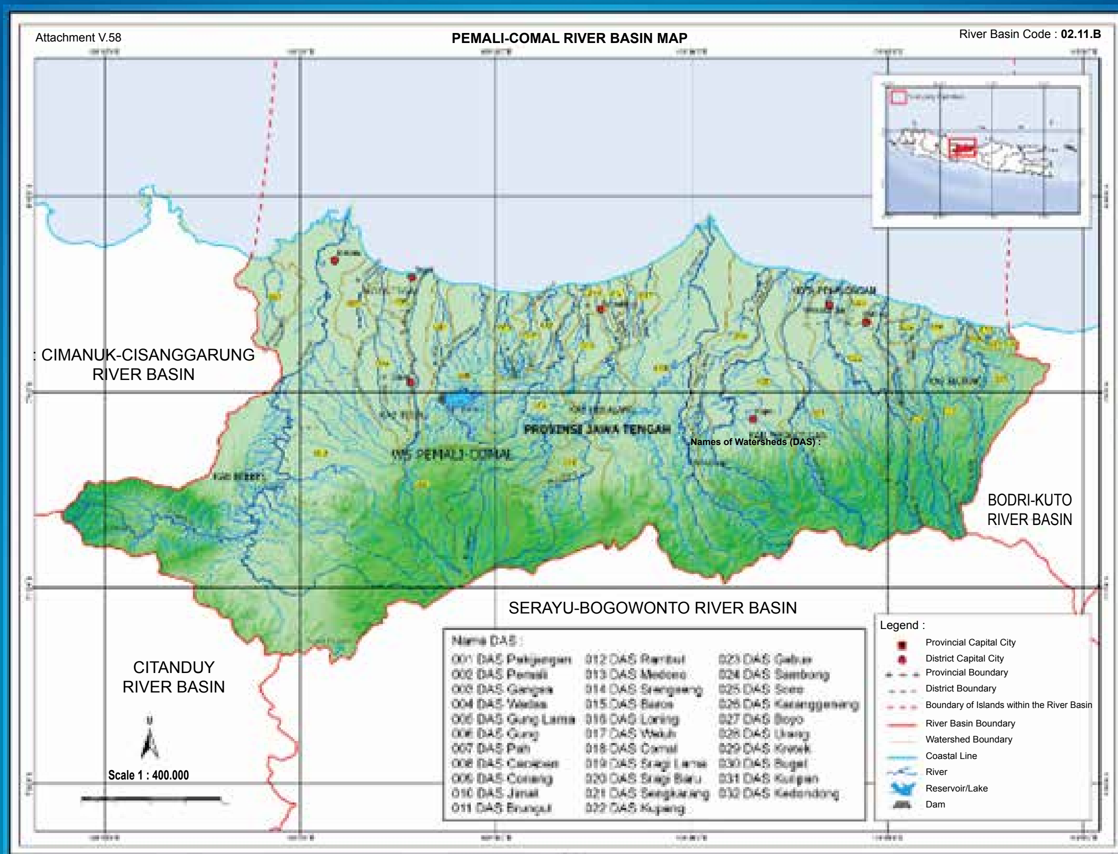
1) Babat Barrage, Floodway (Phase 1 LSRP)
2) Rehabilitation of irrigation infrastructures (USRIP)
3) Rehabilitation of *embung* construction
4) Development of Sumber Maron raw water infrastructures
5) Irrigation, River and Reservoir Operation and Maintenance
6) Urgent Countermeasure for Wonogiri Reservoir (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

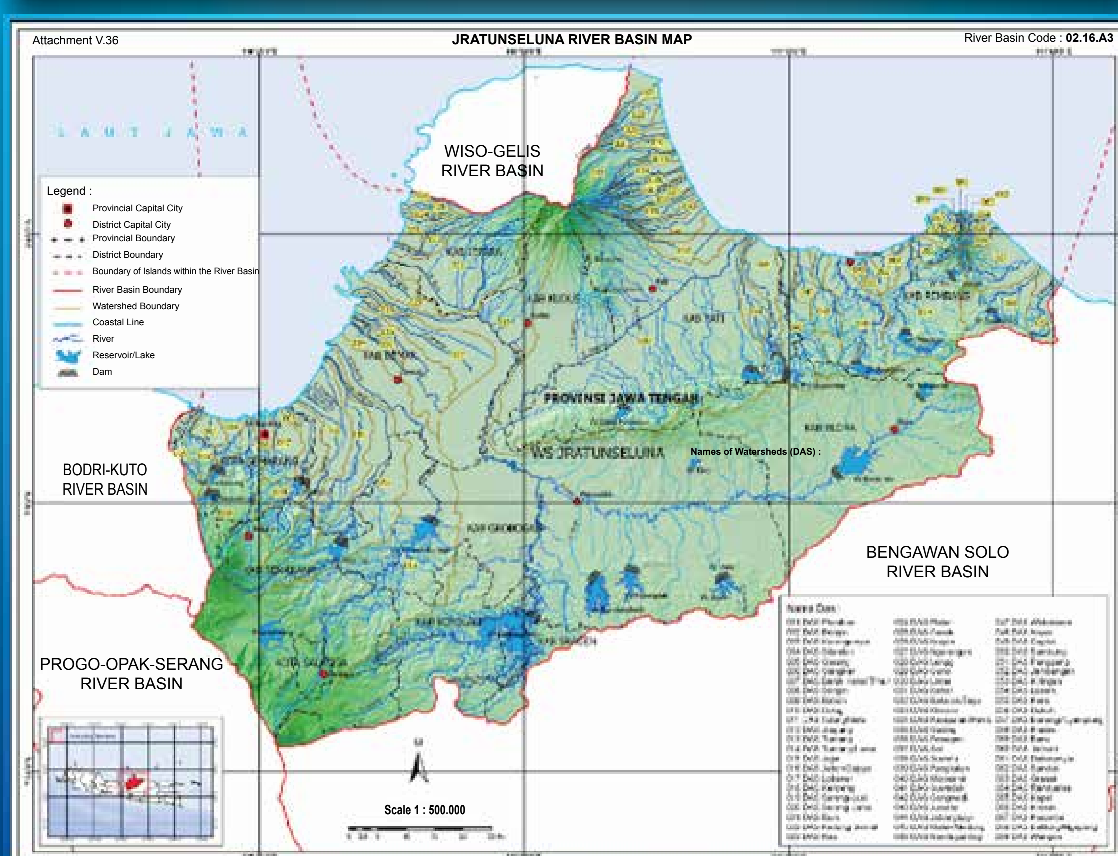
Furthermore, other activities are scheduled to be implemented until 2014, involving 7 groups with 30 activity packages and costs amounting to 11.860 billion rupiahs, as seen in the following table.

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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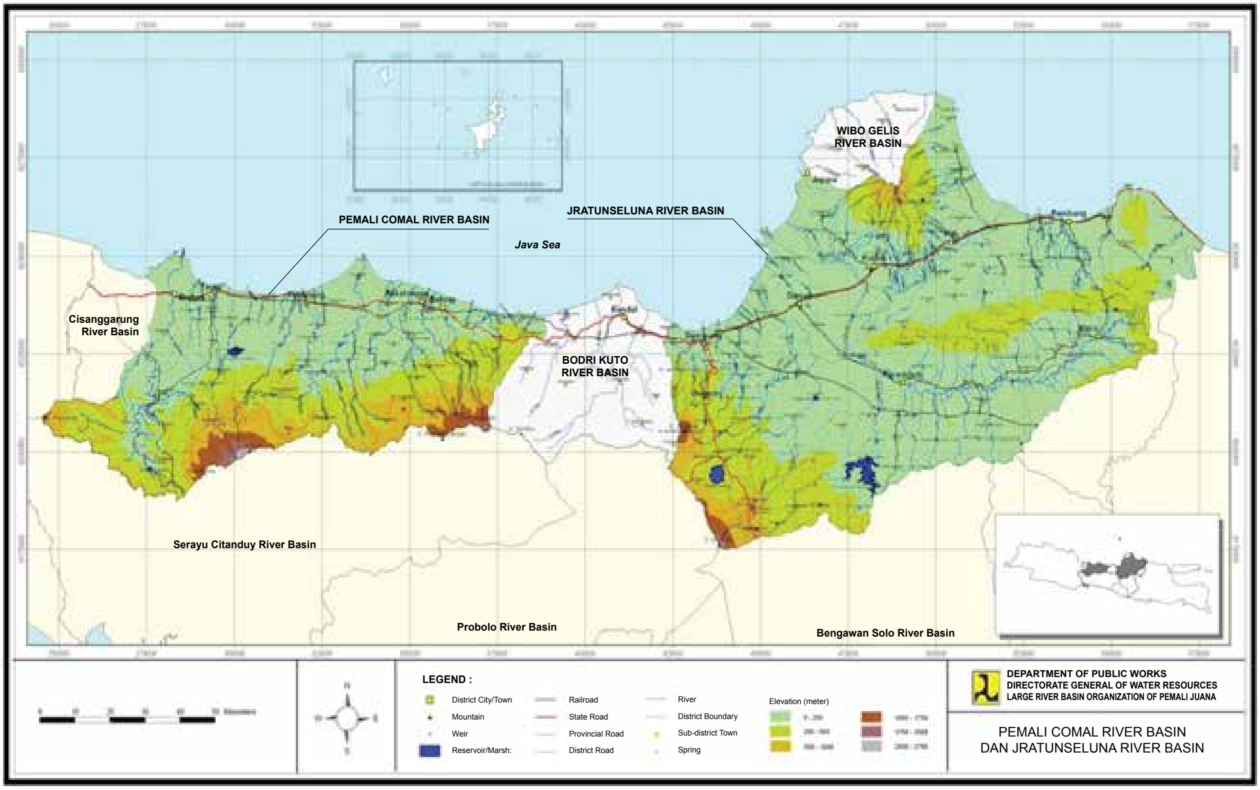


Figure 1: Work Area of BBWS Pemali-Juana

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 Juanawas 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.

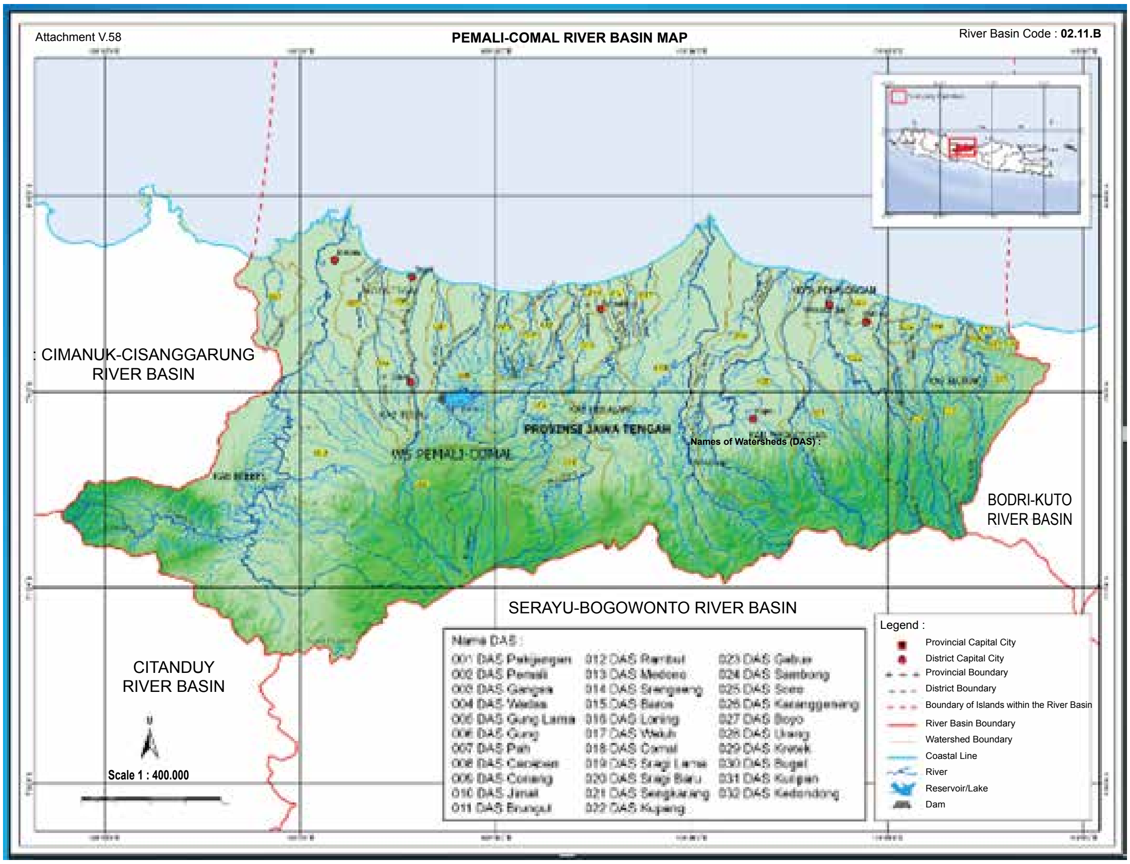


Figure 2: Pemali-Comal River Basin

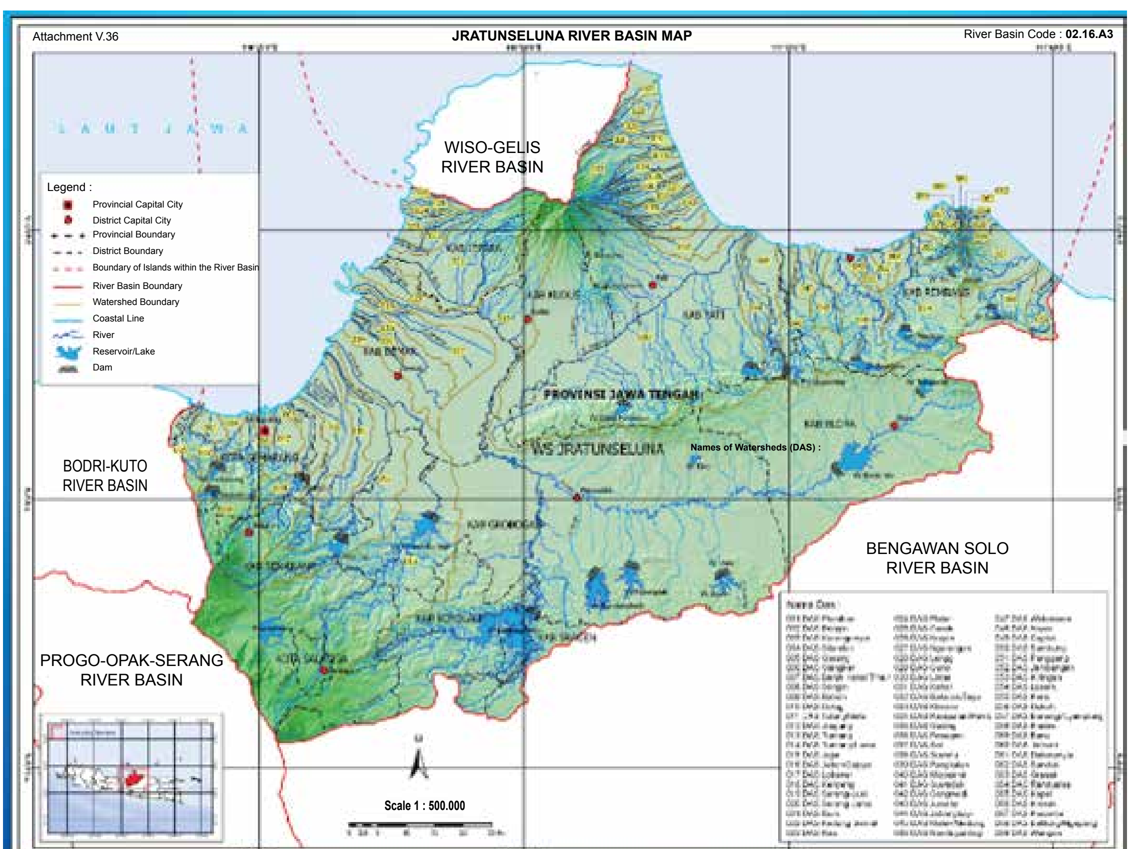


Figure 3: Jratunseluna River Basin

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 m^3/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 dischargesin the Pemali Comal River Basin are as follows:

- Lowest discharge is found in Loning/Waluh River, at 1 m^3/sec.
- Highest discharge is found in Comal River, at 130 m^3/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)].

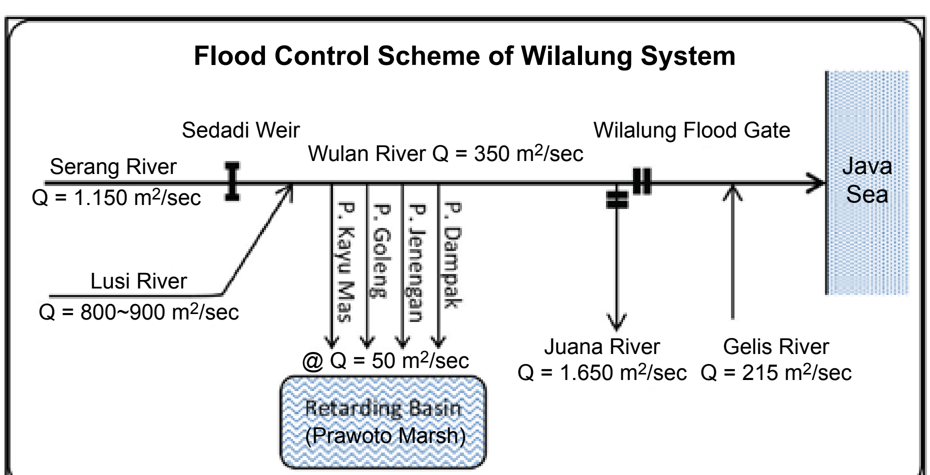


Figure 4: Flood Control Scheme of Wilalung System

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%.

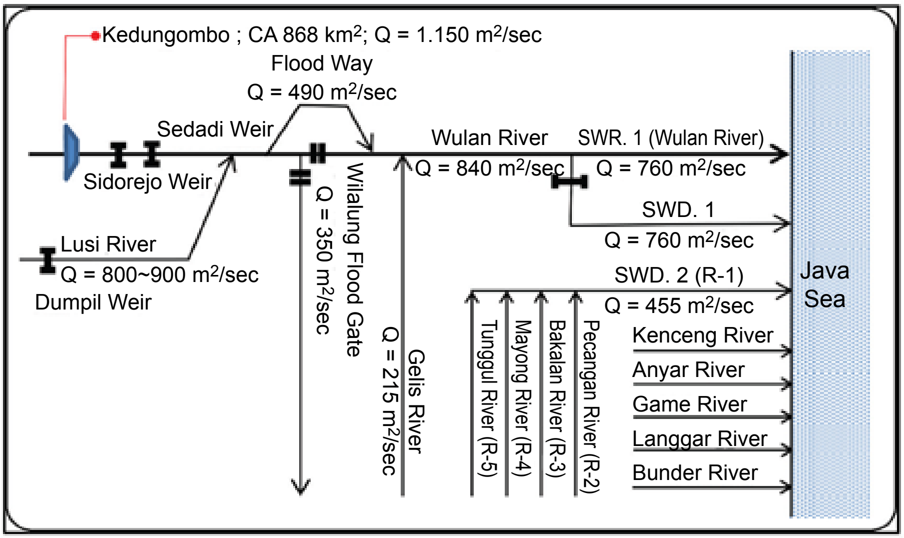


Figure 5: CIWA Scheme

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.

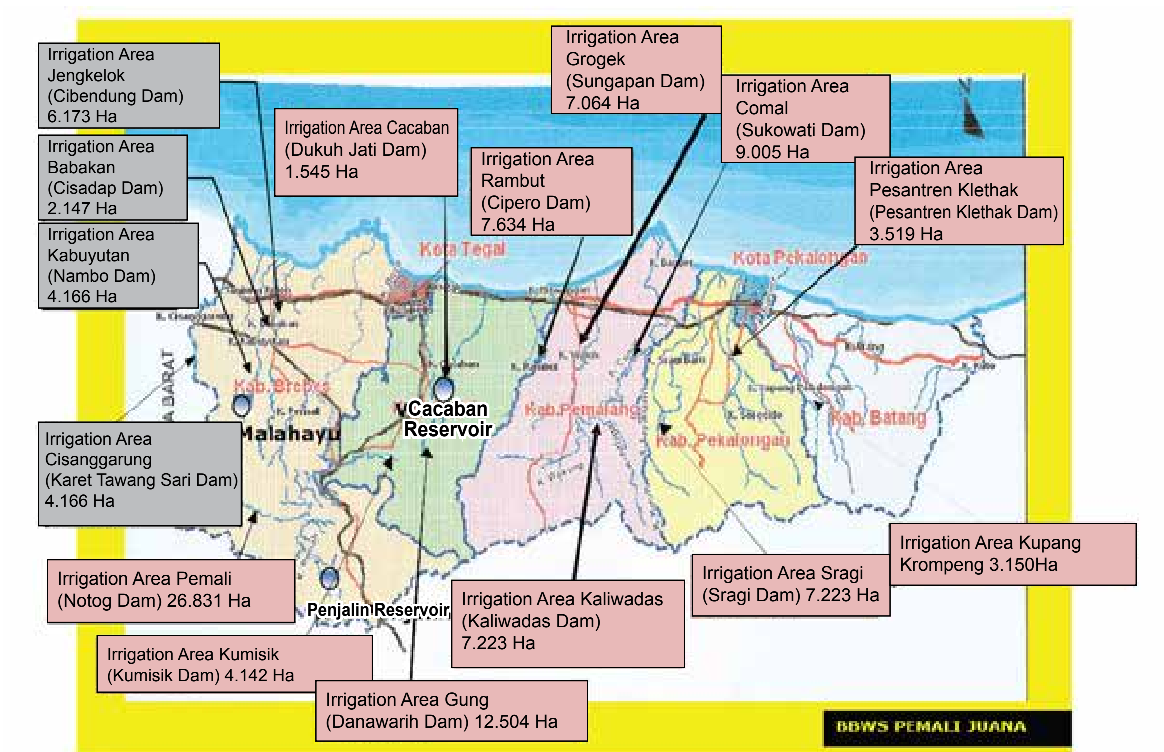


Figure 6: Irrigation Areas in Pemali Comal River Basin

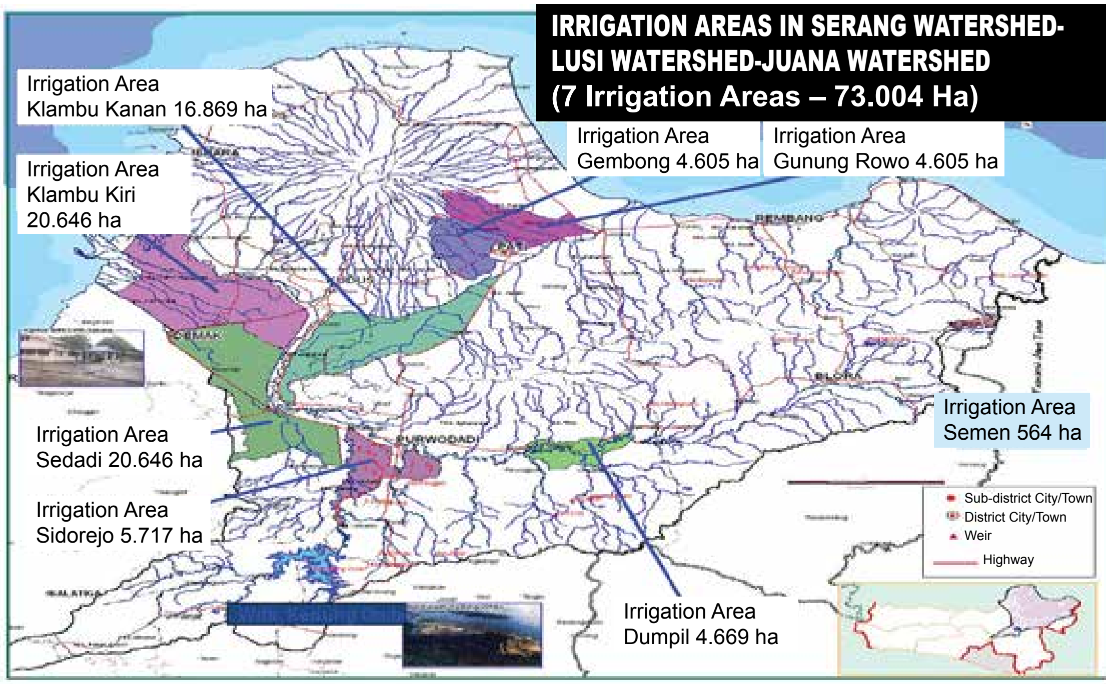


Figure 7: Irrigation Areas in Jratunseluna River Basin

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

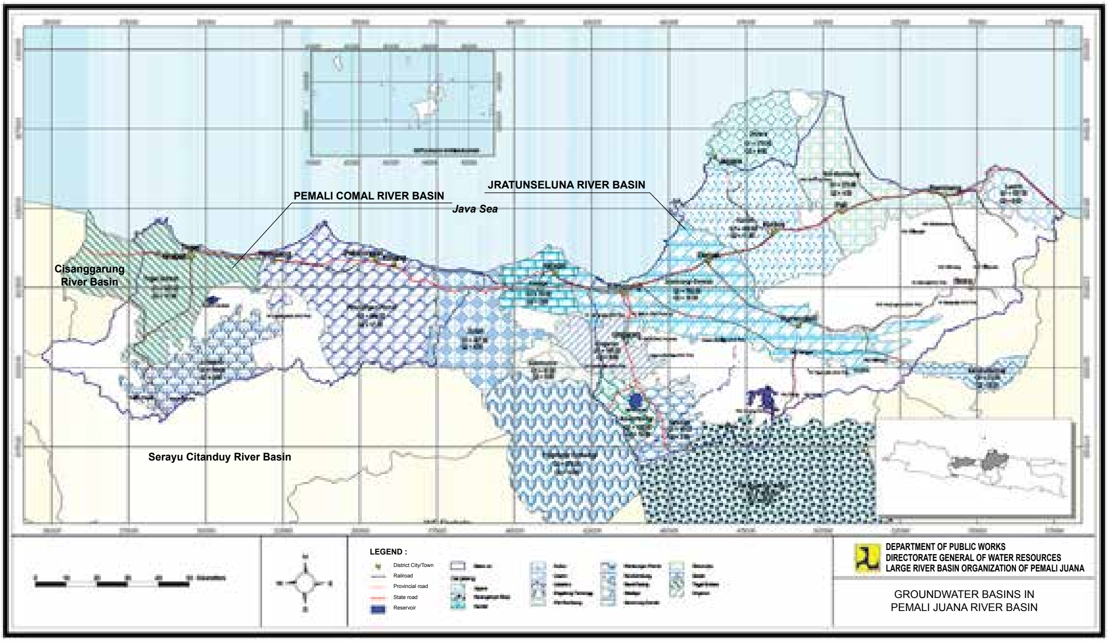


Figure 12: Groundwater Potential Map of Pemali Juana

2.3. Control of Water Destructive Power

Floods serve as the main issue in the lowlands of the Jratunseluna River Basin. Physical activities carried out to reduce flooding including flood embankments, river expansion, retention areas, flood regulator and others only reduce the risk of flooding. A flooding that is caused by tides, which is known as sea water flooding, occurs mainly in the city of Semarang. Sea water flood inundations or tidal runoff in the northern part of Semarang City reach a total area of 2,115 hectares or increased compared to the total inundated area in 2007 which was still 1,556 hectares.

Flood Control and Coastal Protection:

- Total area protected against the danger of flooding = 67,025 ha.
- Protection of critical coasts in the Northern Coast of Java (100 km).
- River bank erosion mitigation in Pemali River, Sragi River, Sengkarang River.
- Coastal abrasion mitigation.

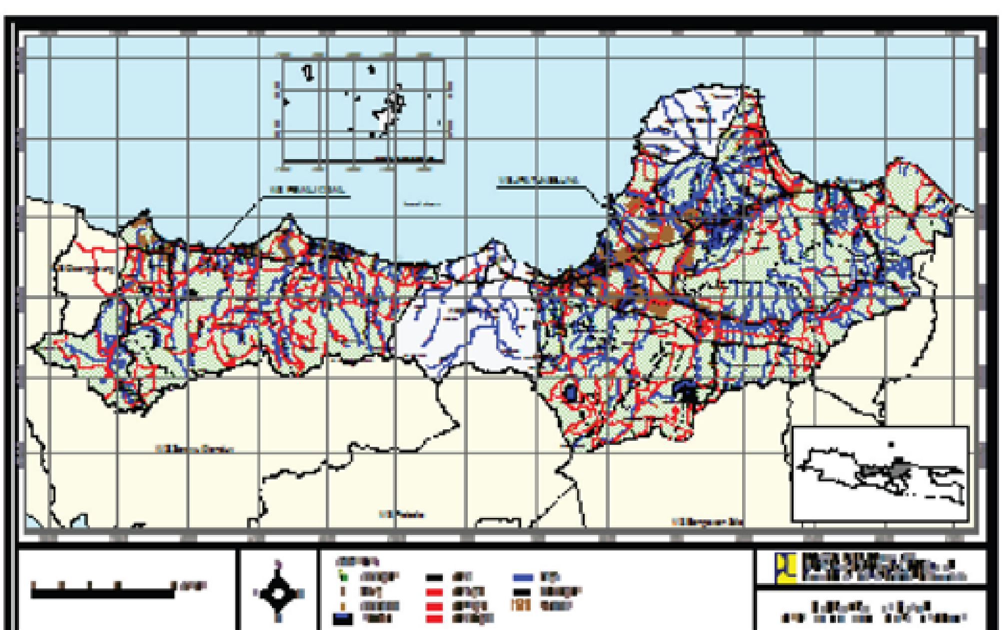


Figure 13: Flood Prone Area Map of Pemali-Juana River Basin

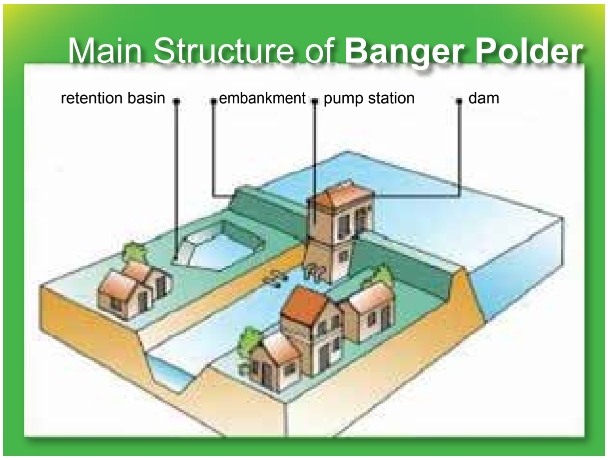


Figure 14: Banger Polder

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.

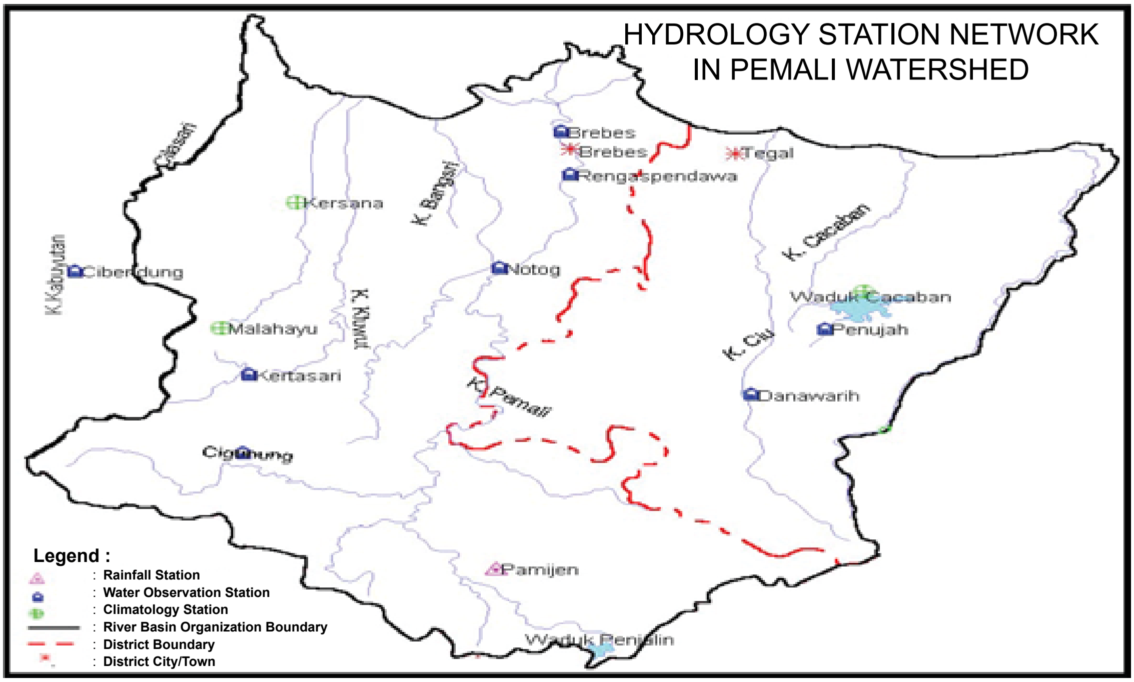


Figure 15: Pemali-Comal Hydrology Station

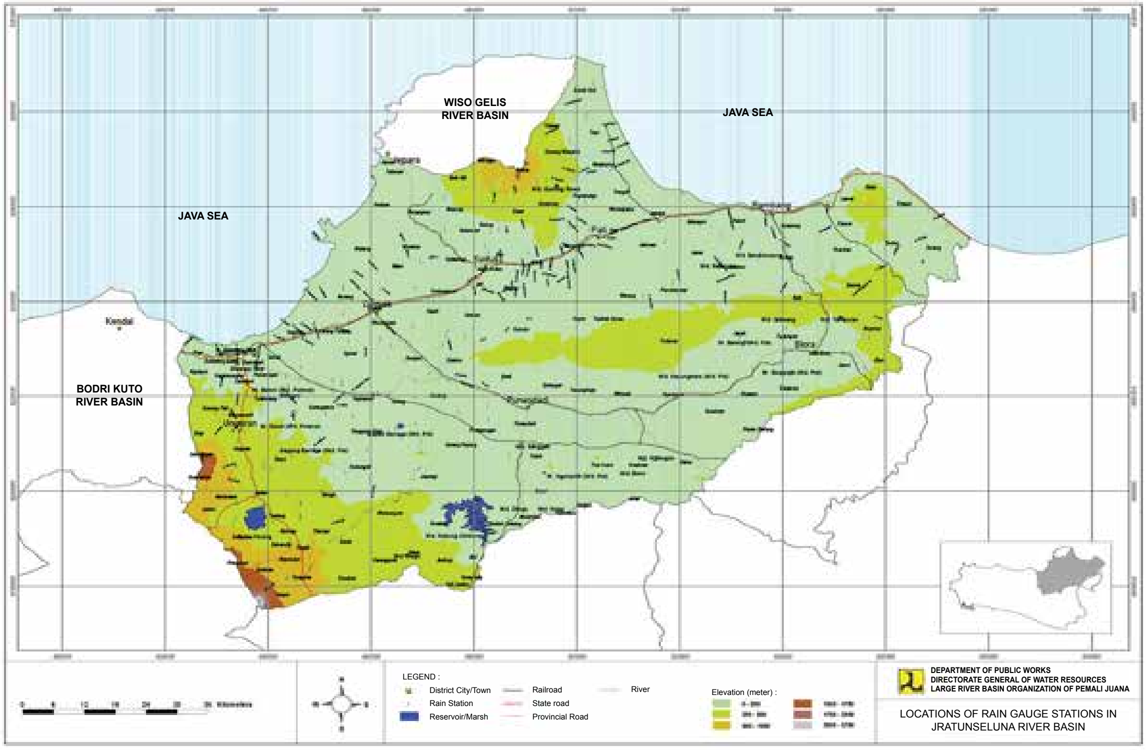


Figure 16: Jratunseluna Rain Gauge Stations

2.5. Community Empowerment, Monitoring and Participation

- The need foralignment 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 isimplementedby 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

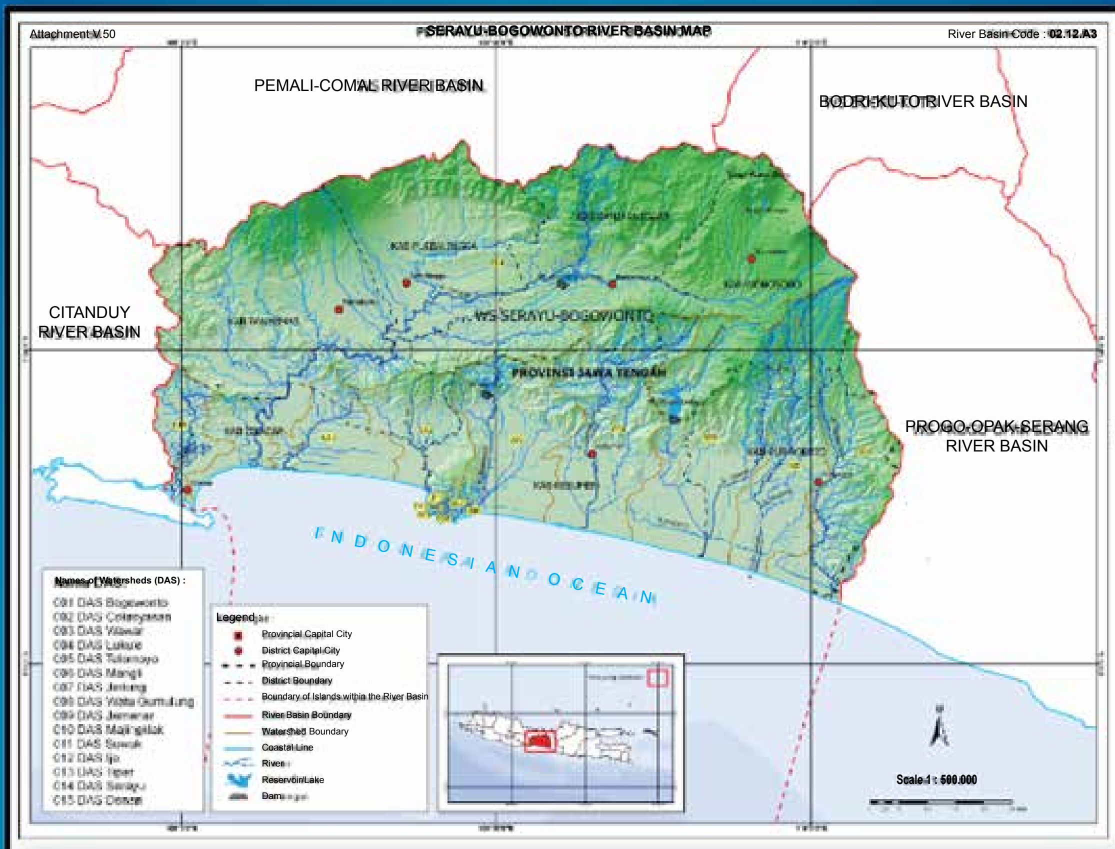
Water resources management requires the provision of water resources data and information that are accurate, timely, continuous and easy to access by developing an integrated provincial or regency/municipal water resources information system network for Jratunseluna River Basin and Pemali Comal River 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.

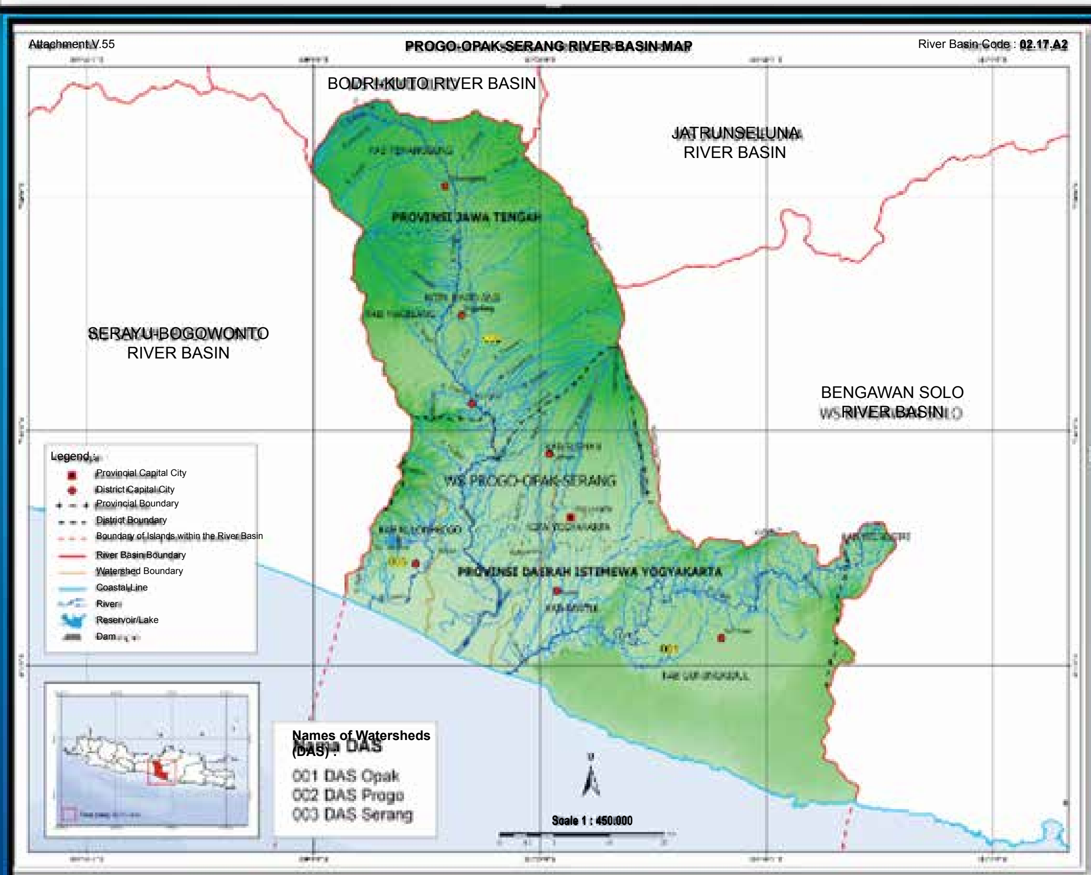
3.4. Empowerment and Participation Improvement of the Community, Private Sector and Regional Government

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) andprogo 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:

a) Flood Control and Coastal Protection Project for Serayu Bogowonto
b) Water Resources Development and Management Project for Serayu Bogowonto
c) Flood Control and Coastal Protection Project for the Special Region of Yogyakarta
d) Water Resources Development and Management Project for the Special Region of Yogyakarta
e) Raw Water Supply Project for the Special Region of Yogyakarta
f) Mainstay Irrigation Project for the Special Region of Yogyakarta, and
g) 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 BalaiBesar 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/municpalities, namely Cilacap, Banyumas, Purbalingga, Banjarnegara, Wonosobo, Temanggung, Magelang, Purworejo, Kebumen, Municipality of Jogjakarta, Sleman, Bantuland 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 km^2, consisting of Serayu Bogowonto River Basin (7,344 km^2) and Progo-Opak-Serang River Basin (4.993,85 km^2). (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 (± 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, Purworejoin Central Java Province and Kulon Progoin 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 to7,017,348 people with a growth rate of 0.73%.

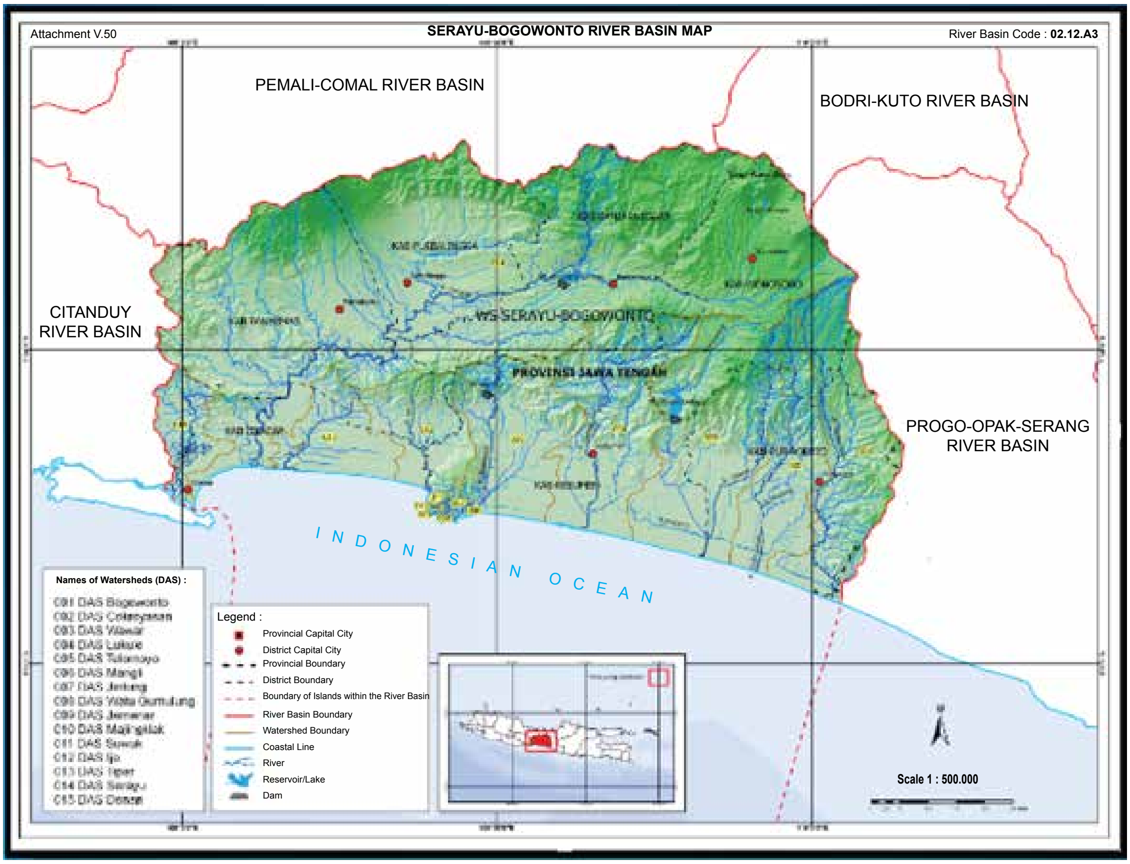


Figure 3: Serayu-Bogowonto River Basin

- **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.

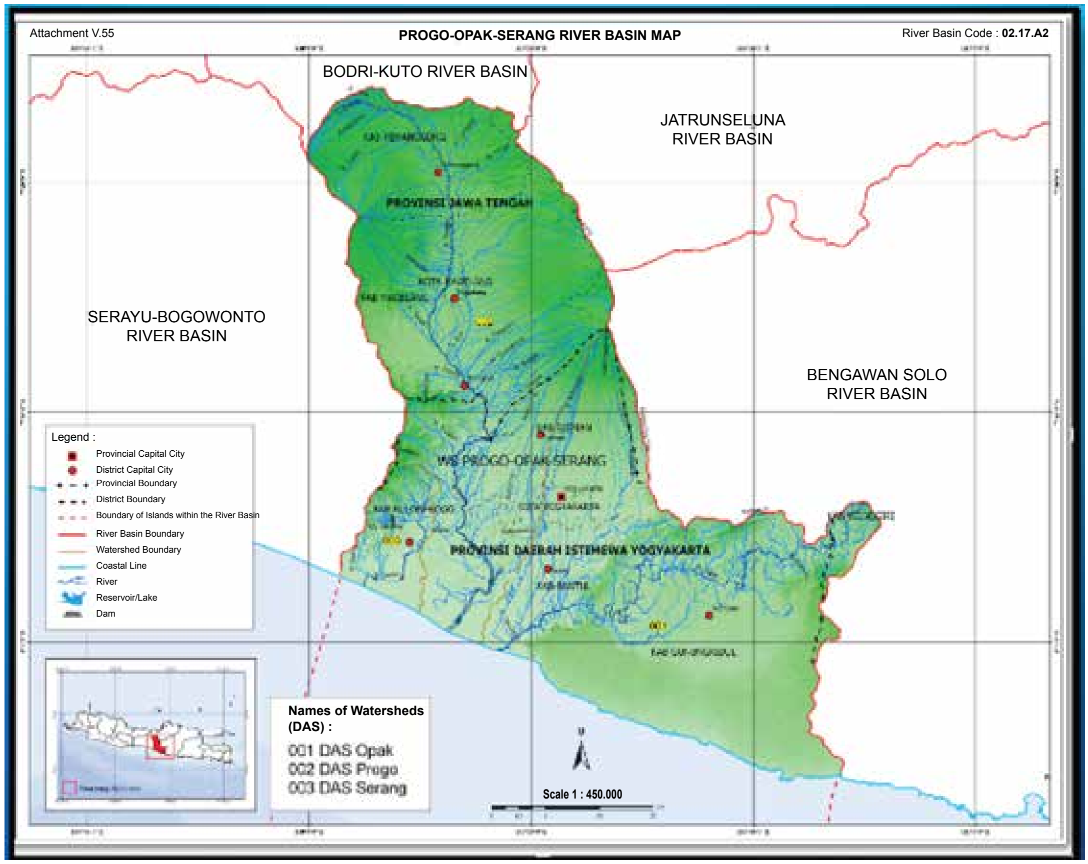


Figure 4: Progo-Opak-Serang River Basin

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 variesfrom 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 Onservation 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

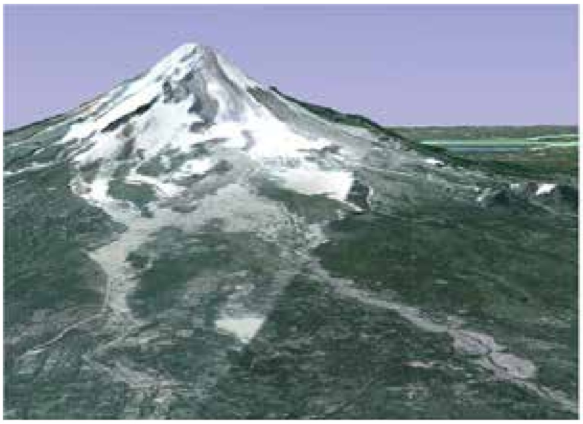


Figure 5: Mount Merapi

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 ofs and, 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. Afterheavy 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 akrst 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 m^3 is calculated to drop to Rp,- per m^3.

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

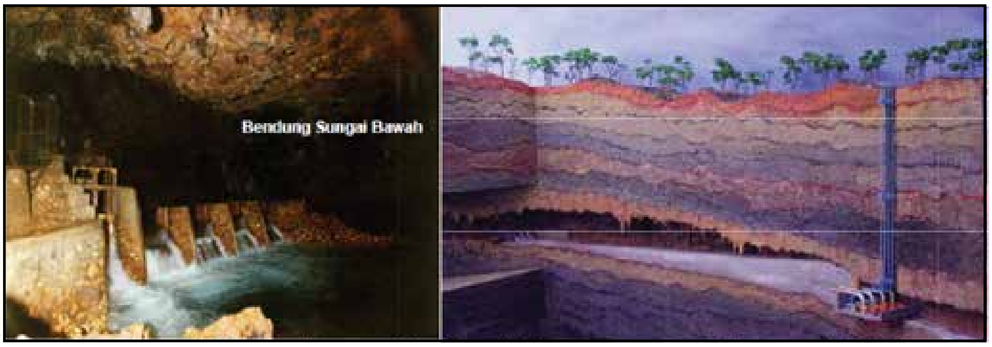


Figure 6: Weir and Pump Turbine in Bribin River

Figure 7: Bribin Cave

1.7. Budget Allocations

The cost budgetsof 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

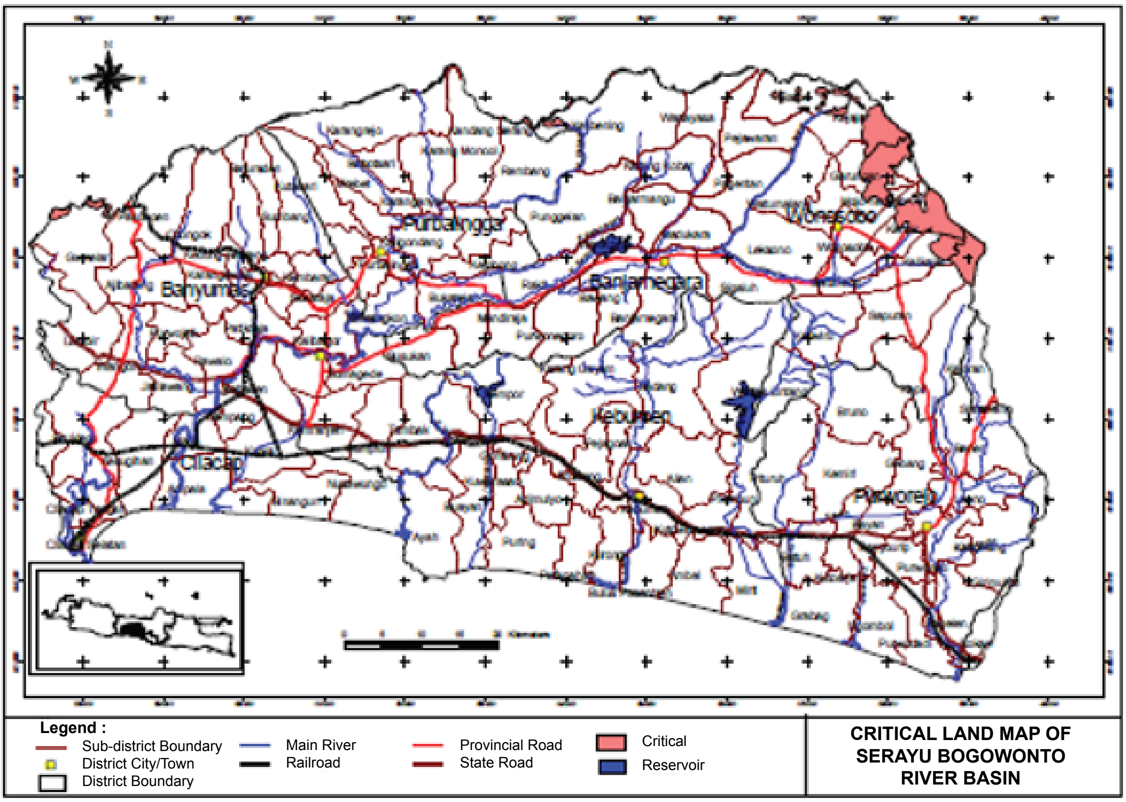
a) Critical Lands

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 erotion 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

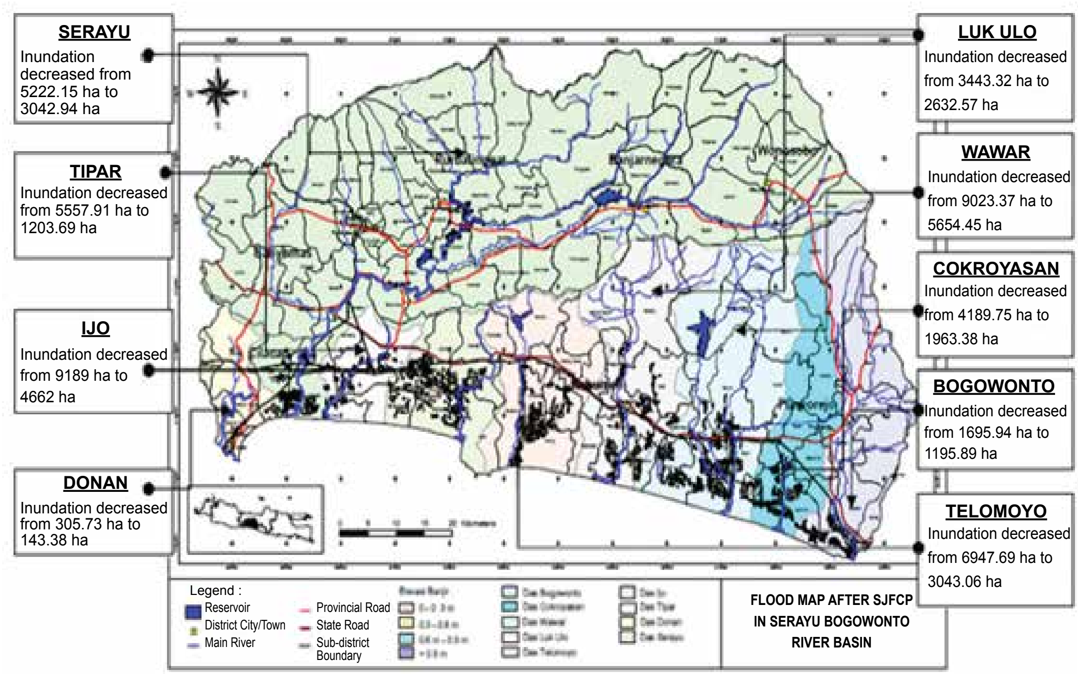
RIVER	STATION	Qmax (m^3/sec)	Qmin (m^3/sec)	Qmax/Qmin
Progo River	Sta Duwet	213	1.06	201
	Kalibawang	331	12	28
	Badran	103	5.76	18
	Borobudur	205	6.56	31
Opak River	Karangsemut	83.2	1.89	44
Oyo River	Bunder	128	0.26	492
Serang River	Durungan	10.83	0.28	39

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 Water-shed	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**



Sources : South Java Flood Control Project

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 m^3, 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

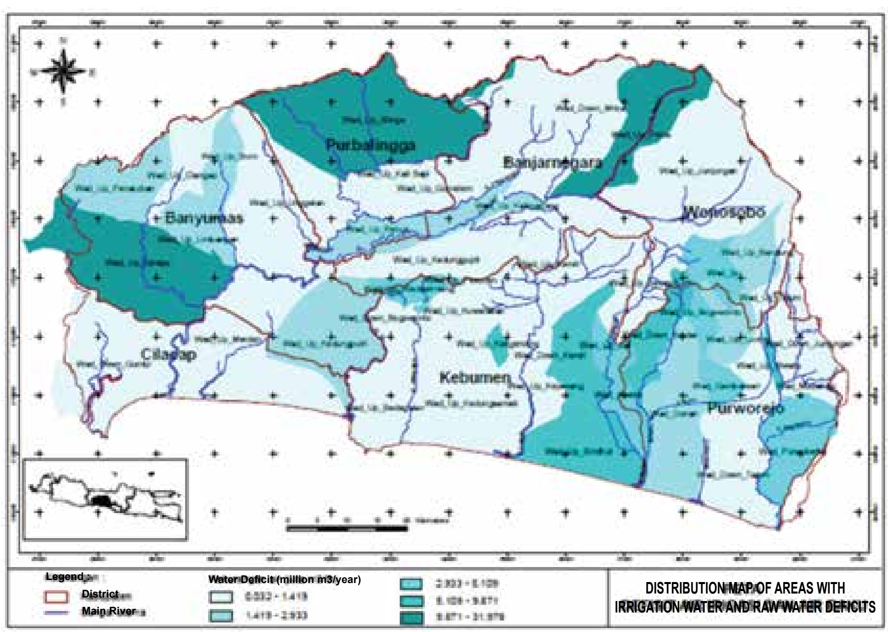


Figure 13: Spread of Water Deficit Areas

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.

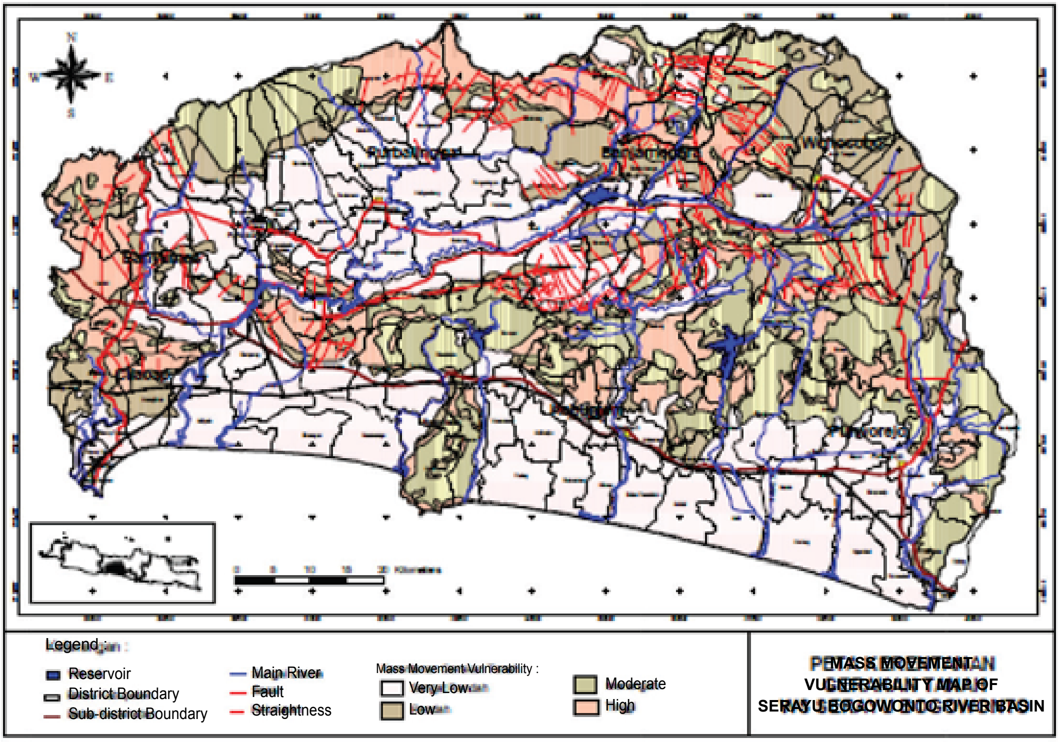


Figure 14: Areas Vulnerable to Mass Movement

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 5,347,017people. 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.

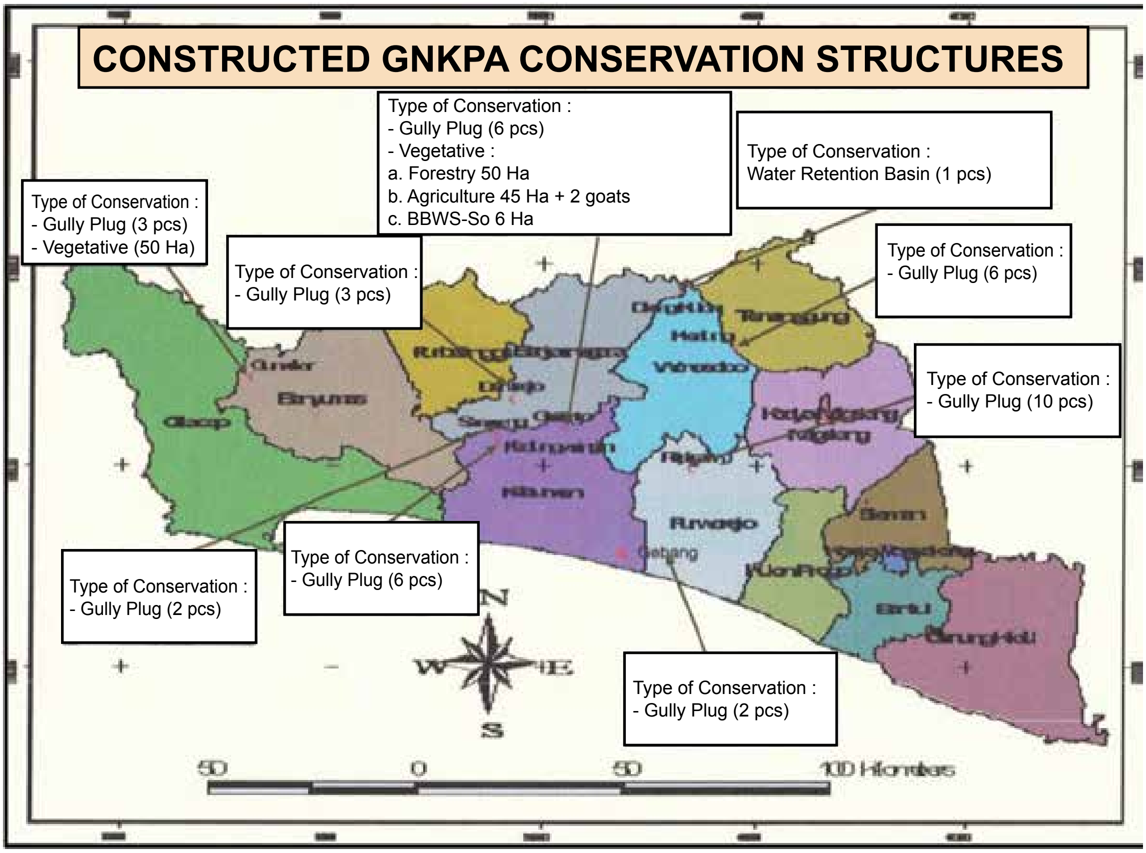


Figure 17: Locations of Conservation Activities

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:

a) Normalization of Gatel River and Bagor River

b) Rehabilitation of Consolidation Dams in 5 (five) locations, namely:

- Consolidation Dam of Plumbon and Consolidation Dam of Rogobangsan 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

c) 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 m^3/sec, only 3 m^3/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 fundation 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 hydrolically 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 (M³)
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 barrierto the flow ofthe river, giving rise to flow blockage. Jetties are made to overcome this problem. A jetty is an embankment made uni directional 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

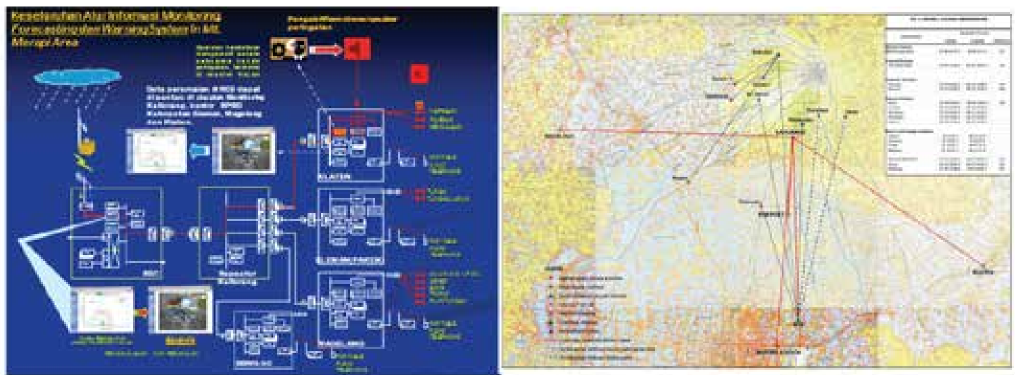


Figure 26: Early Warning on Mount Merapi Debris Flow

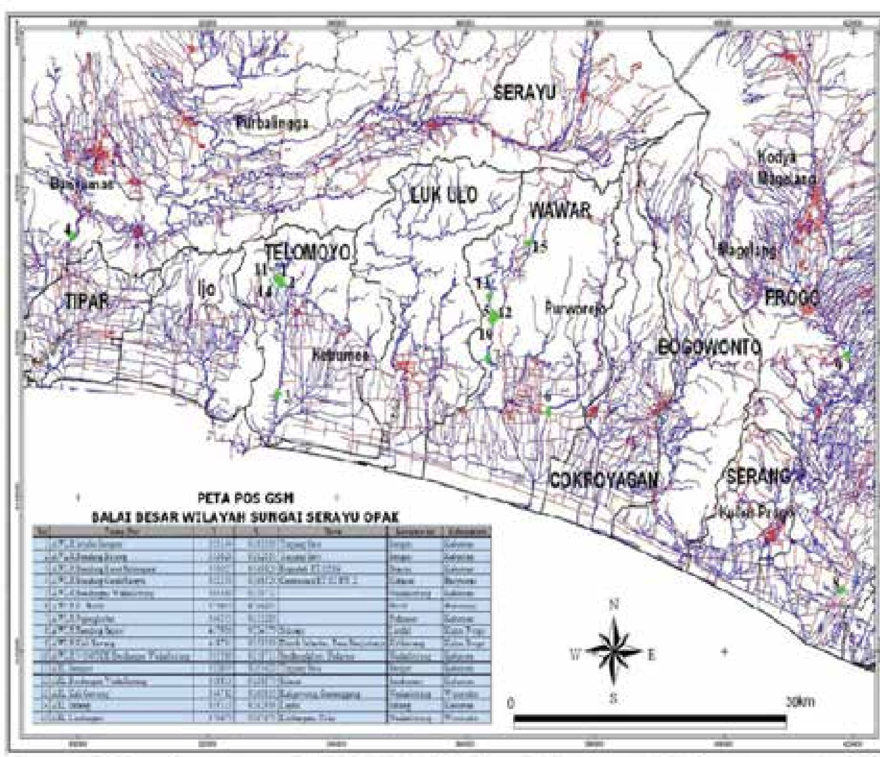


Figure 27: Early Warning of Hydro Telemetry Station(Automatic Water Level Recorder/AWLR and Automatic Rain Logger/ARL)

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 conservationefforts.
- 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

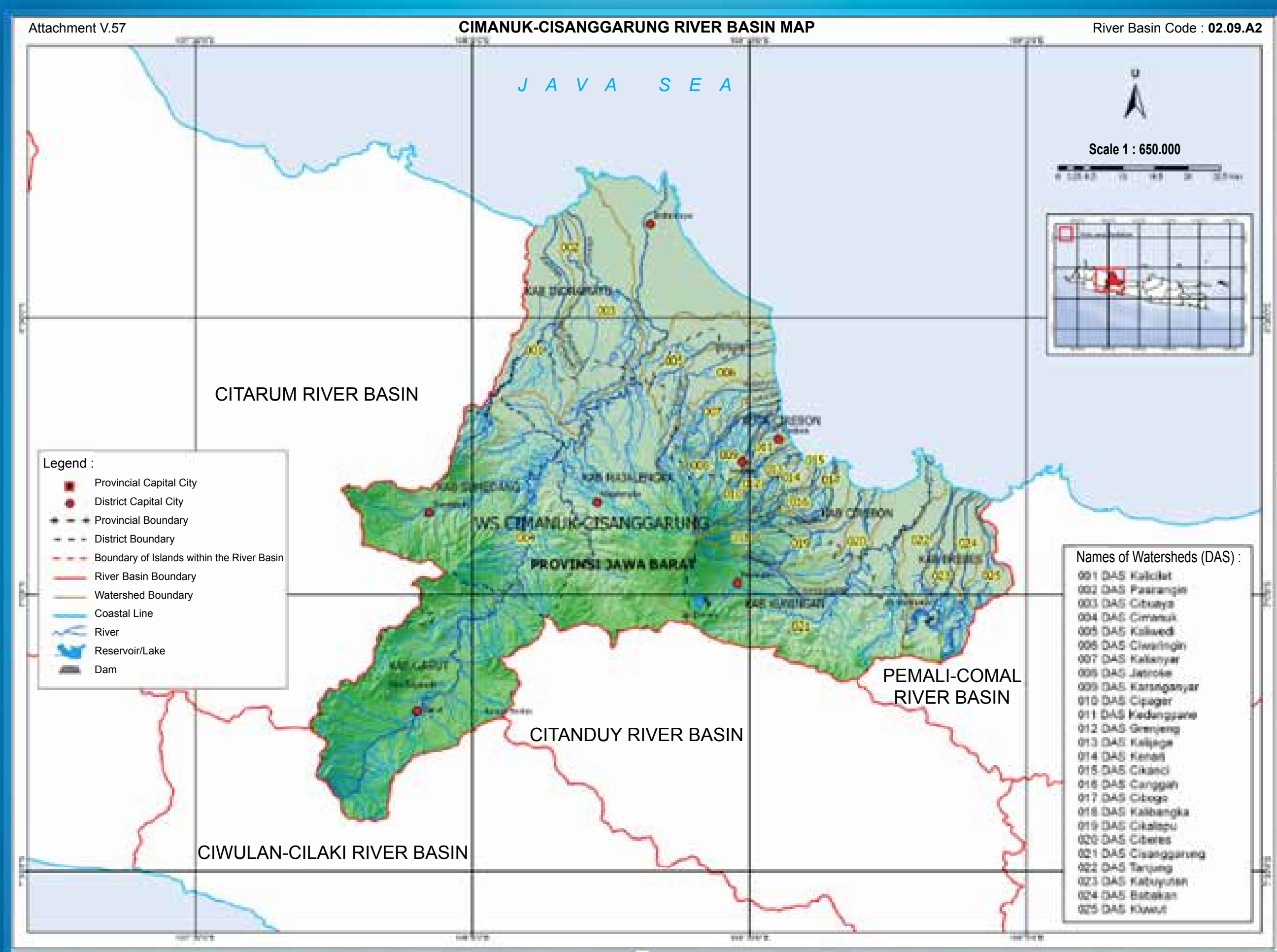
The implementation strategy for comprehensive management in the work area of BBWS Serayu-Opak uses the the following approach:

- 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 necesary 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.

A5. LARGE RIVER BASIN ORGANIZATION OF CIMANUK-CISANGGARUNG



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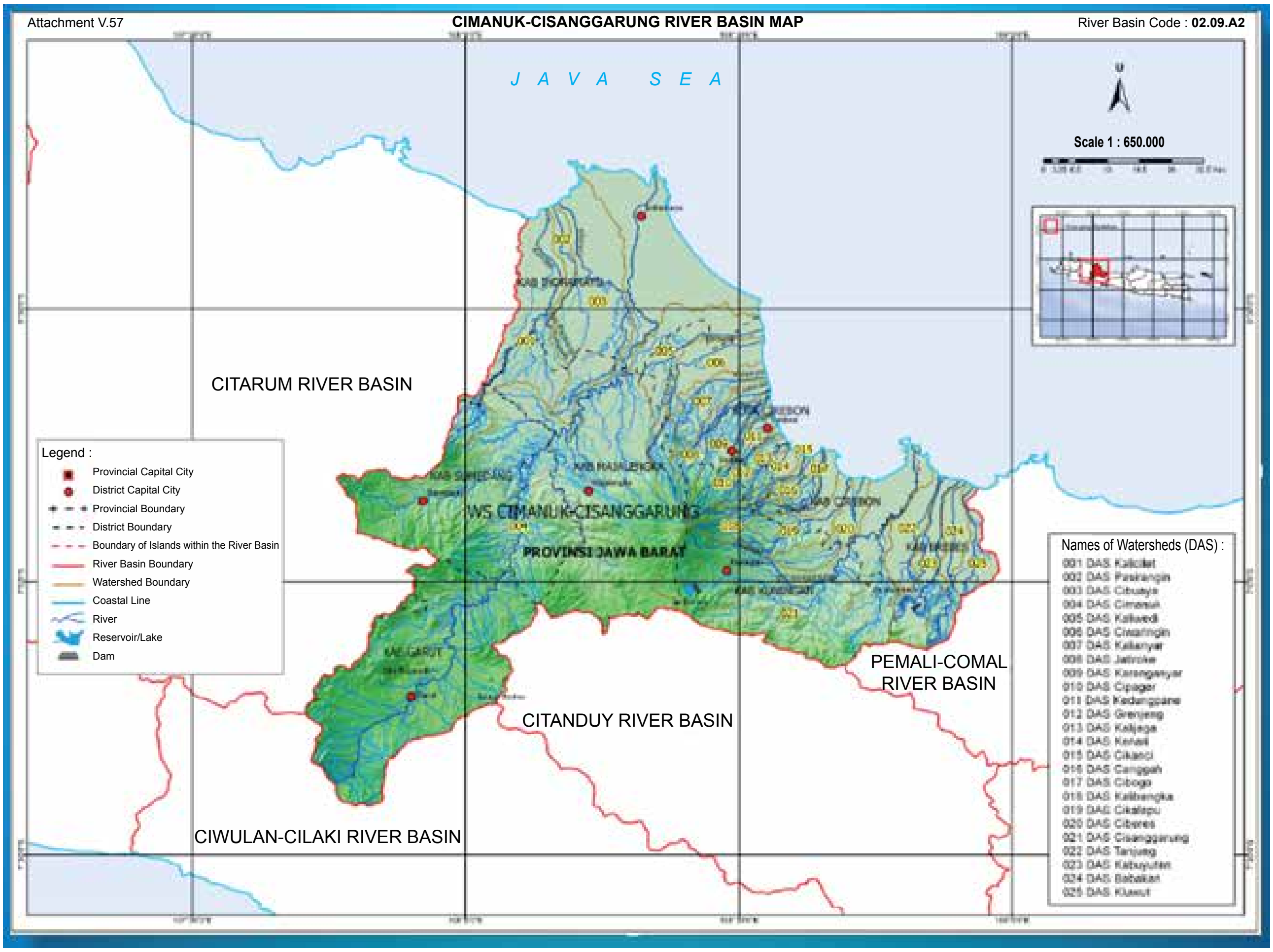


Figure 1: Cimanuk-Cisanggarung River Basin

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-CisanggarungRiver Basin
River Basin Classification	:	Cross-Provincial River Basin (West Java Province–Central Java Province)

1.2. Brief History

1969/1970 to 1970/1971	CimanukSub 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 Cisanggarungis 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 CimanukCisanggarung River Basin Management.

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

1.4. General Condition of Work Area

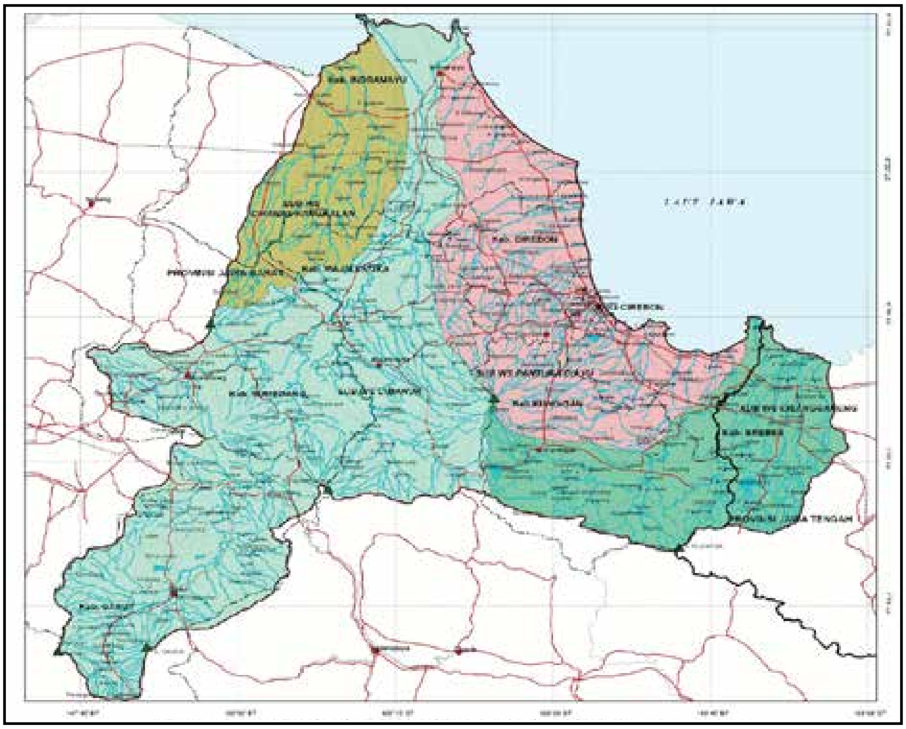


Figure 2: Cimanuk—Cisanggarung Sub-River Basin

Geographically, the Cimanuk—CisanggarungRiver 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	
	(km²)	AREA OF WATERSHED (km²)	%
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 KuninganClimatology 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 m^3/sec, and 774 tributaries ranging from first order to fifth order. The Cisanggarung River has a length of 104 km, flood discharge of 712 m^3/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		
Sub River Basin of Cipanas - Pangkalan		
1	Cipanas Watershed	489,24
2	Pangkalan Watershed	502,44
Sub River Basin of Pantura - Cirebon		
1	Prawirokepolo Watershed	68,70
2	Prawirodarung Watershed	13,84
3	Gebangsawit Watershed	44,09
4	Gabus Watershed	36,57
5	Glayem Watershed	11,79
6	Kamal/Dadap Watershed	40,20
7	Cigedang Watershed	17,59
8	Bobos Watershed	21,87
9	Pamengkang Watershed	29,67
10	Kumpulkuwista Watershed	155,13
11	Ciwaringin Watershed	138,84
12	Terwu Watershed	13,29
13	Sriganala Watershed	43,00
14	Winong Watershed	112,63
15	Bondet Watershed	153,95
16	Condong Watershed	33,80
17	Pekik Watershed	66,73
18	Tangkil/Kedungpane Watershed	37,01
19	DAS Sukalila Watershed	16,00
20	DAS Kesunean Watershed	48,50
21	Jaga Watershed	40,97
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**

Watersheds According to Presidential Decree Number 12/2012	
001	Kalolet Watershed
002	Pasirangin Watershed
003	Cibuaya Watershed
004	Cimanuk Watershed
005	Kaliwedi Watershed
006	Ciwaringin Watershed
007	Kalianyar Watershed
008	Jatiroke Watershed
009	Karanganyar Watershed
010	Cipager Watershed
011	Kedungpane Watershed
012	Grenjeng Watershed
013	Kalijaga Watershed
014	Kenari Watershed
015	Cikanci Watershed
016	Canggah Watershed
017	Cibogo Watershed
018	Kalibangka Watershed
019	Cikalapu Watershed
020	Ciberes Watershed
021	Cisanggarung Watershed
022	Tanjung Watershed
023	Kabuyutan Watershed
024	Babakan Watershed
025	Klumut Watershed

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 Qmax is 1,004 m^3/sec, while the Qmin is 4 m^3/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 occuring 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 m³/ha/ year	5.2 mm/ year
Upper Cimanuk Sub-watershed	2007	57 m³/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 m^3/year and groundwater potentials area approximately 0.9 billion m^3/year. Judging from thenumbers, the amount of potentials is quitebig, butjudging from thedistribution ofthe time andlocation ofthe spread, it is notprofitable. 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	RentangdanFloo 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 Iirrigation system that is believed to be more efficient in the use of irrigation water.

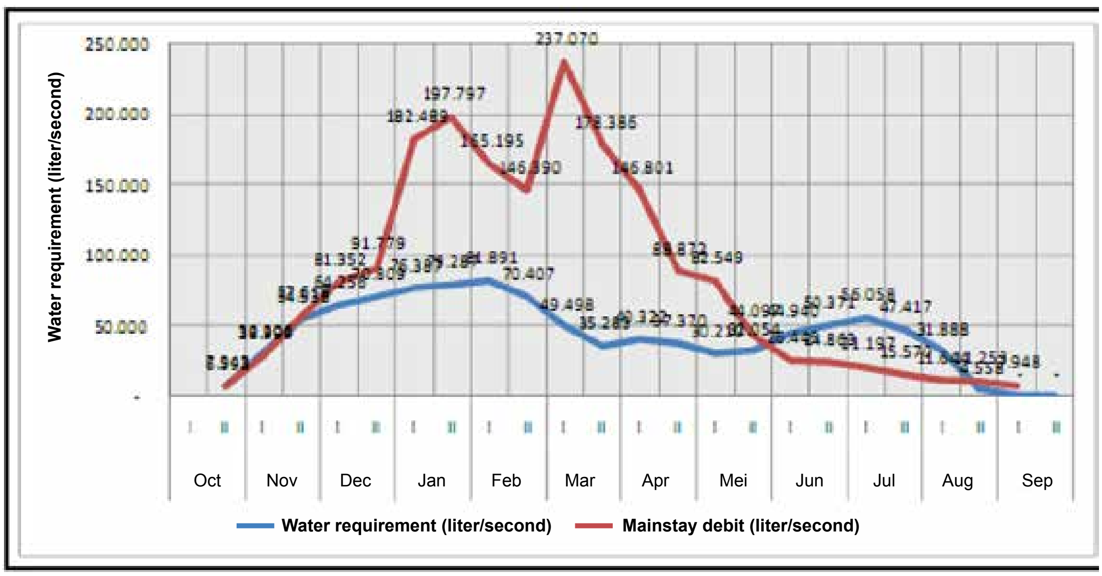


Figure 13: Irrigation Water Requirements of Rentang Irrigation Area

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 seasont 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 cultivationis suitable for the dry season, while shrimp cultivation is suitablefor the rainy season, where the availability of water is greater becauseof 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 PanturaCiayu 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 m^3/second) or equivalent to ..?.., household, urban, and industrial water (11,765 m^3/second or equivalent to 3,62%). Water requirements for fish ponds are estimated to reach 13,283 m^3/second or 4,09%. The remaining water, amounting to 159,529 m^3/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 JengkelokAtas.

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 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 Jengekelok. 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.

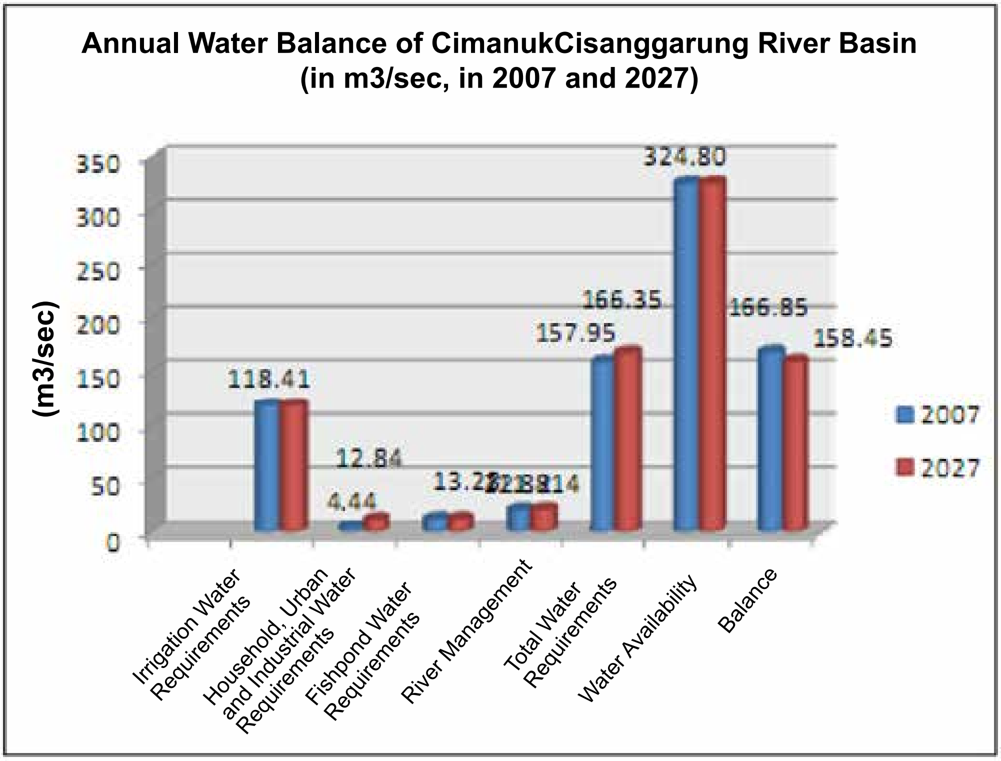


Figure 14: Water Balance in 2007 and 2027

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.

- Cibatu 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. Cibatu	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. Kudamalik	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.

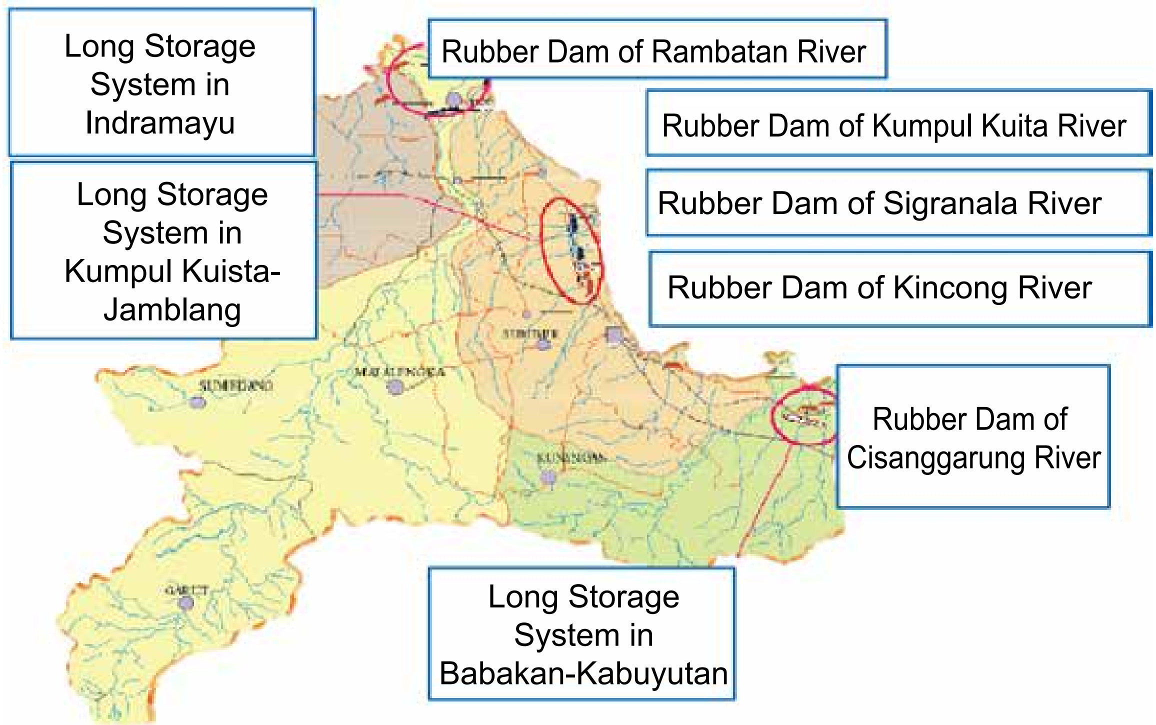
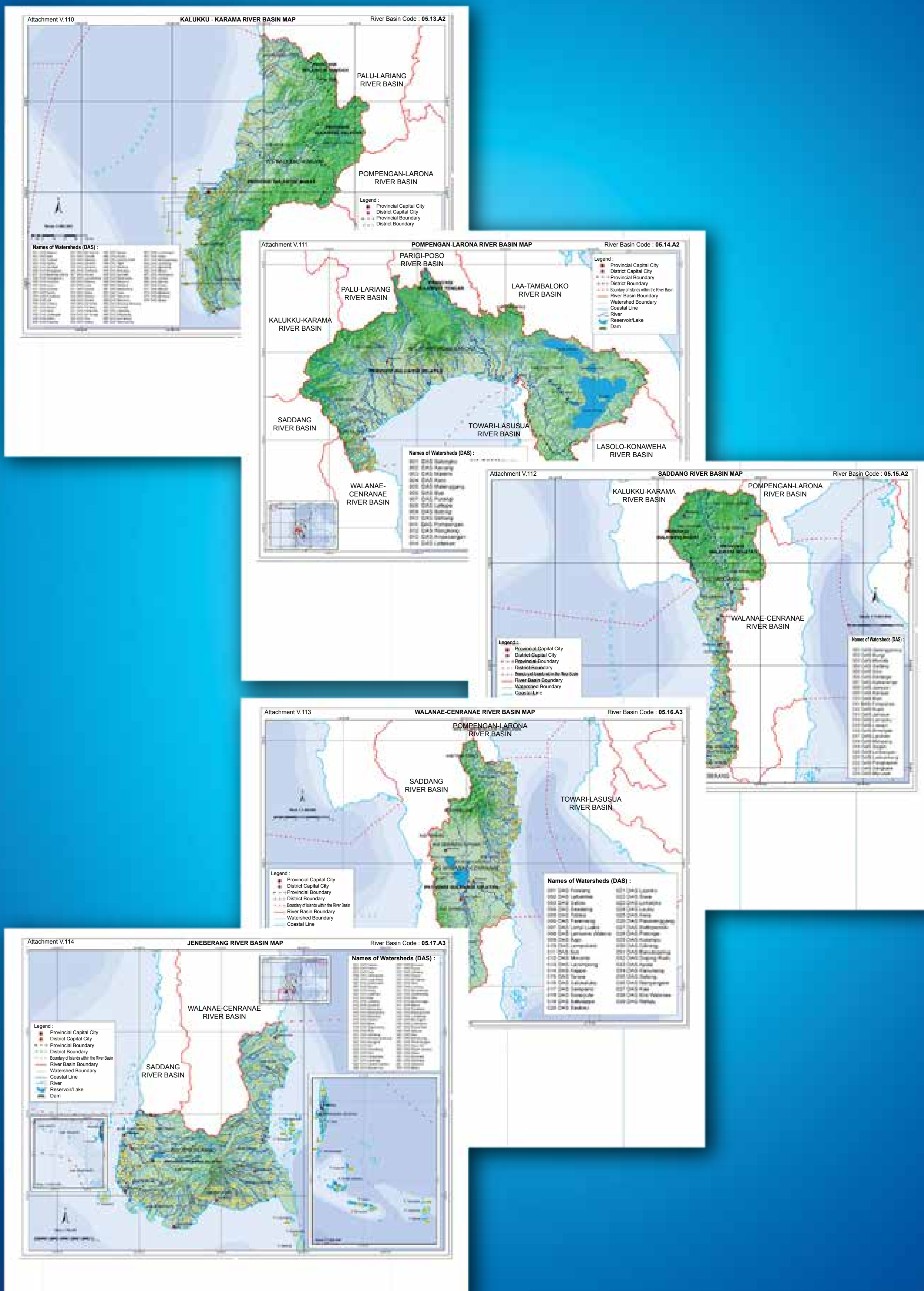


Figure 15: Raw Water Development Potentials

A6. LARGE RIVER BASIN ORGANIZATION OF POMPENGAN-JENEBERANG



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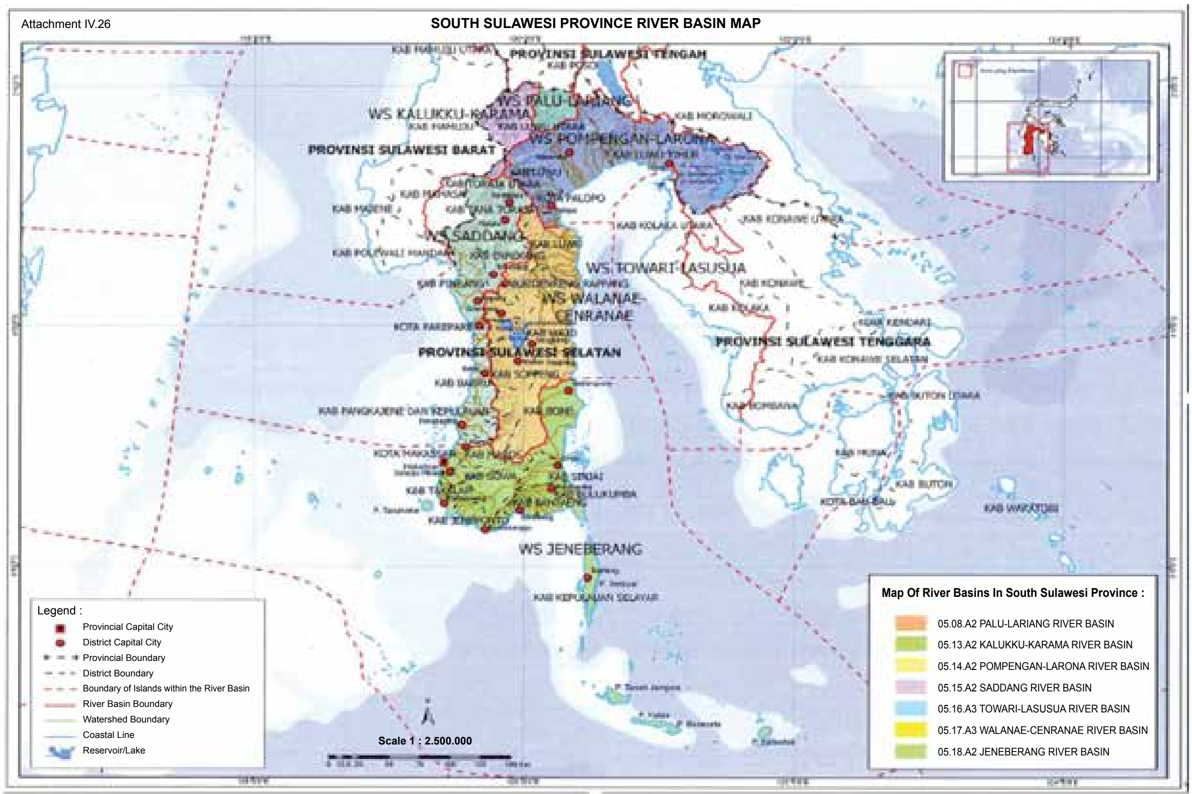


Figure 1: Work Area of BBWS Pompengan-Jeneberang

1.1. General Information

Name	:	Balai Besar Wilayah Sungai Pompengan-Jeneberang
Address	:	Jl. Sekolah Guru Perawat No. 3
Municipality	:	Makassar - 90222
Telephone	:	(0411) 868 781; 868 792
Facsimile	:	(0411) 868 781; 868 792
Website	:	http://www.bbws-pompenganjeneberang.org
E-mail	:	sisda.bbwspj@yahoo.co.id
Legal Basis	:	Regulation of Minister of Public Works Number 23/ PRT/M/2008
Work Area	:	

Name of River Basin	Code	Classification
Kaluku-Karama River Basin	05.13.A2	Cross-provincial
Pompengan-Lorena River Basin	05.14.A2	Cross-provincial
Saddang River Basin	05.15.A2	Cross-provincial
Walanae-Cenranae River Basin	05.16.A3	National Strategic
Jeneberang River Basin	05.17.A3	National Strategic

1.2. Brief History

1986	:	Jeneberang River Improvement Project
1998	:	Master Project for Jeneberang River
2007	:	Balai Besar Wilayah Sungai Pompengan-Jeneberang (Large River Basin Organization of Pompengan-Jeneberang)

1.3. Organizational Structure

The Balai Besar Wilayah Sungai (BBWS) Pompengan-Jeneberang is 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 5 (five) work units in the implementation of the organization's operational budget, namely:

1) Work Unit of BBWS Pompengan-Jeneberang

2) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Source Network Implementationin South Sulawesi

3) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Source Network Implementation in West Sulawesi

4) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Utilization Implementation in South Sulawesi

5) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Utilization Implementation in West Sulawesi

1.4. Human Resources

BBWS Pompengan-Jeneberang has 684 employees, which consist of 515Civil Servants and the rest are Non-Civil Servants.

Table 1: Civil Servant Employees

Educational Level	Technical	Non- Technical	Total
S2 (Master's Degree)	43	5	48
S1 (Bachelor's Degree)	57	109	166
D3 (3-year Associate Degree)	19	5	24
Senior High School	64	171	235
Junior High School	-	19	19
Elementary School	-	23	23
Total	**183**	**332**	**515**

Table 2: Non-Civil Servant Employees

Educational Level	Technical	Non- Technical	Total
S2 (Master's Degree)	-	-	0
S1 (Bachelor's Degree)	17	27	44
D3 (3-year Associate Degree)	2	2	4
Senior High School	12	58	70
Junior High School	-	22	22
Elementary School	-	29	29
Total	**31**	**138**	**169**

1.5. General Condition of Work Area

The work area of BBWS Pompengan-Jeneberang extends to 62,482 km², with a population of 7,520,204 persons (data as per June 2006, www.sulsel.go.id). The work area consists of:

1) Three Provinces, namely:

(1) South Sulawesi Province,
(2) West Sulawesi Province, and
(3) Southeast Sulawesi Province.

2) Eighteen Regencies, namely:

(1)	Bantaeng	(10)	Maros
(2)	Barru	(11)	Pangkajene Islands
(3)	Bone	(12)	Pinrang
(4)	Bulukumba	(13)	Sinjai
(5)	Enrekang	(14)	SidenrengRappang
(6)	Gowa	(15)	Soppeng
(7)	Jeneponto	(16)	Takalar
(8)	Luwu	(17)	TanaToraja
(9)	North Luwu	(18)	Wajo

3) Three Municipalities, namely:

(1) The Municipality of Makassar
(2) The Municipality of Palopo
(3) The Municipality of Pare-pare

4) Five River Basins, consisting of three cross-provincial river basins and two national strategic river basins, namely:

a) Pompengan-Larona River Basin

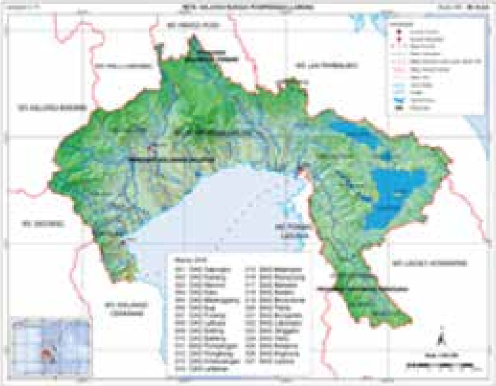


Figure 2: Pompengan-Larona River Basin

The Pompengan-Larona River Basin is a river basin that crosses two provinces, namely the South Sulawesi Province and the Southeast Sulawesi Province. This river basin covers an area of 11,253 km², and consists of 27 watersheds.

The main rivers are the Balease River (length 95 km; area of watershed 995 km²), Kalaena River (length 85 km; area of watershed 1,900 km²), Larona River (length 120 km; area of watershed 4,600 km²), Pompengan River (length 71 km; area of watershed 439 km²).

Other rivers which watersheds cover an area of more than 100 km² are:

(1)	Angkona River	Area of watershed: 385 km²
(2)	Kebo River	Area of watershed: 185 km²
(3)	Rongkong River	Area of watershed: 1.646 km²
(4)	Bangkudu River	Area of watershed: 116 km²

b) Kaluku-Karama River Basin

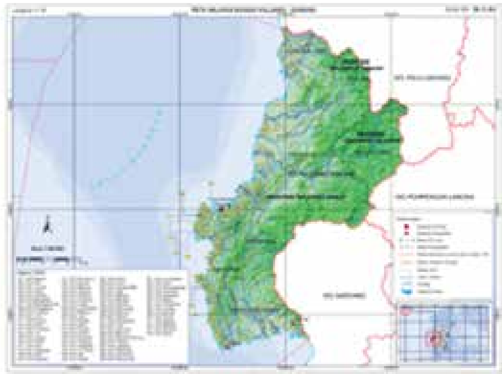


Figure 3: Kaluku-Karama River Basin

The Kaluku-Karama River Basin is a river basin that crosses three provinces, namely the West Sulawesi Province, South Sulawesi Province and Central Sulawesi Province. This river basin covers an area of 12.107 km², and consists of 24 watersheds.

The main rivers are the Karama River (length 150 km; area of watershed 5,574 km²), Budong-Budong River (length 100 km; area of watershed 2,000 km²).

Other rivers which watersheds cover an area of more than 100 km² are:

(1) Kaluku River — Area of watershed: 419 km²
(2) Palapang River — Area of watershed: 150 km²
(3) Lamu River — Area of watershed: 912 km²
(4) Mandar River — Area of watershed: 664 km²
(5) Manyamba River — Area of watershed: 196 km²
(6) Malunda River — Area of watershed: 390 km²

c) Saddang River Basin

Figure 4: Saddang River Basin

The Saddang River Basin is a river basin that crosses two provinces, namely the South Sulawesi Province and the West Sulawesi Province. This river basin covers an area of 7,574 km², and consists of 74 watersheds.

The main rivers are the Mappili/Maloso River (length 114 km; area of watershed 1,712 km²), Saddang River (length 150 km; area of watershed 5,453 km²).

Other rivers which watersheds cover an area of more than 100 km² are:

(1) Galang-galang River — Area of watershed: 140 km²
(2) Kunyi River — Area of watershed: 379 km²
(3) Rappang/Karanjae River — Area of watershed: 777 km²
(4) Pule River — Area of watershed: 381 km²
(5) Polong/Lampe River — Area of watershed: 492 km²
(6) Lipukasi River — Area of watershed: 358 km²
(7) Lampoko River — Area of watershed: 119 km²
(8) KerajaRiver — Area of watershed: 174 km²
(9) Sagiri/Paremba River — Area of watershed: 167 km²

d) Walanae-Cenranae River Basin

Figure 5: Walanae-Cenranae River Basin

The Walanae-Cenranae River Basin is a national strategic river basin that is located in the South Sulawesi Province. This river basin covers an area of 7,380 km², and consists of 39 watersheds.

The main river is the Walane River (length 250 km; area of watershed 740 km²).

Other rivers which watersheds cover an area of more than 100 km² are:

(1)	Gilirang River	Area of watershed: 513 km²
(2)	Siwa River	Area of watershed: 252 km²
(3)	Awo River	Area of watershed: 385 km²
(4)	Paremang River	Area of watershed: 809 km²
(5)	Bajo River	Area of watershed: 390 km²
(6)	Suli River	Area of watershed: 188 km²
(7)	Sampano River	Area of watershed: 178 km²
(8)	Kera River	Area of watershed: 165 km²

e) Jeneberang River Basin

Figure 6: Jeneberang River Basin

The Jeneberang River Basin is a national strategic river basin that is located in the South Sulawesi Province. This river basin covers an area of 9,331 km², and consists of 58 watersheds.

The main rivers are the Jeneberang River (length 80 km; area of watershed 860 km²), and Tangka River (length 65 km; area of watershed 439 km²).

Other rivers which watersheds cover an area of more than 100 km² are:

(1)	Matuju River	Area of watershed: 122 km²
(2)	Pasempa River	Area of watershed: 239 km²
(3)	Barebok River	Area of watershed: 125 km²
(4)	Patiro River	Area of watershed: 330 km²
(5)	Salangketo River	Area of watershed: 296 km²
(6)	Sinjai River	Area of watershed: 130 km²
(7)	Cepek River	Area of watershed: 136 km²
(8)	Aparang River	Area of watershed: 283 km²
(9)	Tiro River	Area of watershed: 190 km²
(10)	Bampang River	Area of watershed: 149 km²
(11)	Balangtiyeng River	Area of watershed: 208 km²
(12)	Bijawang River	Area of watershed: 153 km²

(13)	Jene Klara River	Area of watershed: 357 km²
(14)	Jene Tambaroya River	Area of watershed: 243 km²
(15)	Jene Allu River	Area of watershed: 122 km²
(16)	Jene Cikoang River	Area of watershed: 123 km²
(17)	Jene Pamukulu River	Area of watershed: 389 km²

1.6. Hydrology

Rainfall data are obtained from the 63 rainfall stations in the Jeneberang River Basin. The obtained rainfall data range from the data of 2000 until now.

Table 3: Locations of Rainfall Stations

No	Name of Rainfall Station	No	Name of Rainfall Station	No	Name of Rainfall Station	No	Name of Rainfall Station
1	Maccope	17	Pandang	33	Salomekko	49	Panakukkang
2	Cakura	18	Di Bettu	34	BatuBassi	50	Kampili Dam
3	Bengo	19	Tanralili	35	Komara	51	Serre
4	Manere	20	Bulobulo	36	Likupande	52	Pamukulu
5	Sanregohulu River	21	Lekopancing River	37	Bayang-bayang	53	Pamukulu Dam
6	Maroangin	22	BPA Walenna	38	Aparang River	54	Jenemarung
7	Pakeli	23	Bantimurung	39	Kampili	55	Cakura
8	Balantieng River	24	Aparang III	40	Malino	56	Malolo
9	Toata	25	Onto	41	Marrada	57	Pappa Watershed
10	Pamukulu Watershed	26	Tino Toa Pnk	42	Mangempong	58	BontoKappong
11	Paitana	27	Falakka Dam	43	BiliBili	59	Bangkeke
12	Salojirang	28	Seka	44	Jonggoa	60	Kalamisu
13	Camming	29	Maloloi	45	Limbunga	61	Bulukamase
14	Palaka River	30	Kampili	46	Maros Watershed	62	Sinjai Kota
15	Padangloang	31	Moti	47	Salojirang	63	Tangka Watershed
16	Pallatae	32	Kelara Dam	48	Takalar		

1.7. Watersheds, Rivers and Tributaries

The work area of BBWS Pompengan-Jeneberang, which consists of five river basins, has 222 watersheds, with details of each river basin as shown by the following Table 4:

Table 4: Watersheds and Main Rivers

River Basin	Watersheds	Main Rivers	Rivers with Watersheds > 100 Km²	Rivers with Watersheds < 100 Km²
Pompengan – Larona River Basin	27	4	4	19
Kaluku - Karama River Basin	74	2	6	66
Saddang River Basin	24	2	9	13
Walanae - Cenranae River Basin	39	1	8	30
Jeneberang River Basin	58	2	17	39
Total	**222**	**11**	**44**	**167**
	100%	**5%**	**20%**	**75%**

There are 11 main rivers or 5% of the total number of watersheds, while the number of rivers which watershed areas are more than 100 km² is 44 rivers or 20% of the total number of watersheds, and the remaining are rivers which watershed areas are less than 100 km².

1.8. Budgets of 2010, 2011, and 2012

The BBWS Pompengan-Jeneberang receivesits budget from the Budget Implementation List (DIPA), andthe budget has continued to increase in the past three years. In fact, the 2012 Budget Implementation List increased more than twice that of the 2010 Budget Implementation List, as shown in Table 5 below.

Table 5: Budget Implementation List (DIPA) of BBWS Pompengan-Jeneberang

Type of Fund	FY 2010	FY 2011	FY 2012
Employee Expenditures	7,644,609	6,076,612	9,857,352
Goods Expenditures	30,843,435	51,968,502	66,964,894
Capital Expenditures	424,565,354	684,139,601	864,830,886
Total	**463,053,398**	**742,184,715**	**941,653,132**

1.9. Issues

a. Forest Damages, Forest Conversion, and Crop Conversion

Forest damages, forest conversion, and crop conversion occur mainly in upstream area, which is in Gowa Regency. The area functions as a conservation area as well as a water catchment area. Most of the agricultural lands in the area have been converted into horticultural lands. This brought negative impacts on environmental carrying capacity which leads to increased areas of critical lands, surface erosion and increased runoff.

In Jeneberang Watershed, there are critical lands extending to 219.74 km², spread over the areas of Takalar Regency, Gowa Regency, and the City of Makassar. Forest areas now extend to only 8,259 hectares or 13.3%, far below the normal limit of 47% as mandated by Law Number 41 of 1999 on Forestry.

At present, the Jeneberang Watershed is dominated by dry-land farming which covers an area of 29,334 hectares (47.52%). The area of underbrush is larger than forest area, which is 12,530 hectares (20.3%). This condition causes an increase on the rate of erosion that leads to the Bili-bili Dam.

b) Floods

Flooding in agricultural and residential areas is caused by the inability of river channels to accommodate riverwater discharge. Frequent flooding occurs in some rivers, namely the Maros River, Sinjai River, Bialo River, PappaRiver, Allo River, Tamanroya River, Calendu River, Pampang River and Tallo River.

Flood events data recorded between 2005 to 2009 showed 14 flood events with various inundation areas, inundation levels and inundation durations,as follows:

Figure 7: Floods in Moncongloe, Manggala and Biringkanaya sub-regencies, January 2012

- Inundation areas: 50 to 8,000 hectares;
- Inundation levels: 100 to 400 cm;
- Inundation duration: 3 hours to 2 days.

The records also showed that flooding also occurred in Mangottong, Kalamisu, Tangka, Bikeru, Balantieng, Teko, Kelara, Tarowang, Pokobulo, Tonra and Bontomanai watersheds. The floods also inundated plantation areas, fisheries, and infrastructures such as roads, bridges and canals, and also caused some casualties.

c. Erosion and Sedimentation

The increase in erosion and sedimentation has led to siltation and decreased water storage capacity, especially in Maros Watershed, Pappa Watershed, and Tamanroya Watershed.

In Jeneberang Watershed, the erosion and sedimentation that occurred were extraordinary due to the collapse of Mount Bawakaraeng's caldera or crater wall. Due to the collapse of the caldera, until March 26, 2004, it was estimated that as many as 250 to 300 million m³ of materials slid into the Jeneberang Watershed.

A survey conducted in 2008 shows that there are still materials in a volume of 145 million m³ which are in an unstable condition and have the potential to cause a collapse, as follows:

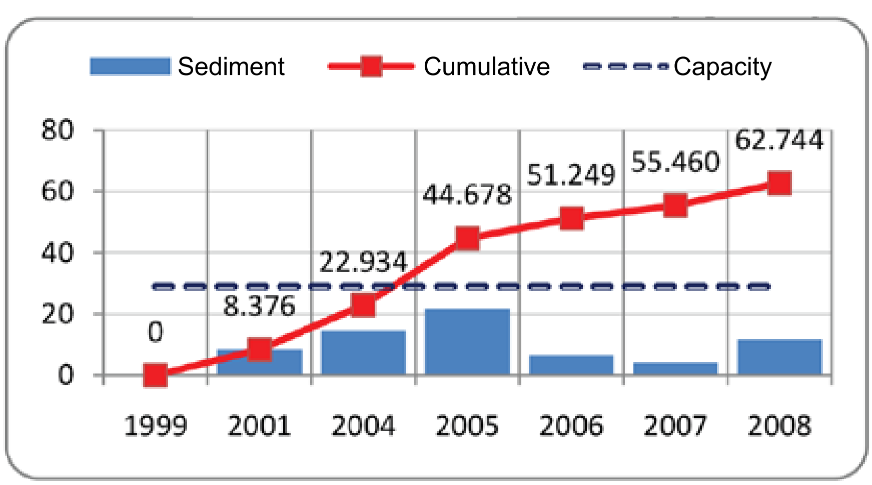
- North Caldera : 12,906,500 m³
- East Caldera : 111,073,000 m³
- South Caldera : 21,088,500 m³
- Total : 145,068,000 m³

Such phenomenon has caused disasters in residential areas, fields, estates, and 1,500 hectares of agricultural lands and infrastructures including school buildings in the downstream area. As many as 32 persons died due to being buried by the slide and no less than 6,333 people were evacuated from their homes.

This longsoran slide has changed the river body that was filled with deposits and also caused sedimentation in Bili-bili Reservoir. Results of the BBWS Pompengan-Jeneberang survey show that sedimentation in Bili-bili Reservoir amounted to 22,934 million m³, in which 14,558 m³ of the total amount occurred in 2004 after the Bawakaraenglongsoran.

Meanwhile, the sediment storage (dead-storage) volume of the Bili-bili Reservoir is only 29 million m³, as shown in Table 6 below.

Table 6: Sedimentation Rates of Bili-bili Reservoir (x million m³)



Source: BBWS Pompengan-Jeneberang

The cumulative amount of the sediments that entered into the reservoir until 2008 will reach more than 62 million m³. Therefore, it will certainly lead to tremendous losses and multiplier effects that could even reach the dam's lower area if no quick and appropriate measure is taken to overcome the problem. The Bili-bili Dam itself is located only 35 kilometers away from the caldera wall.

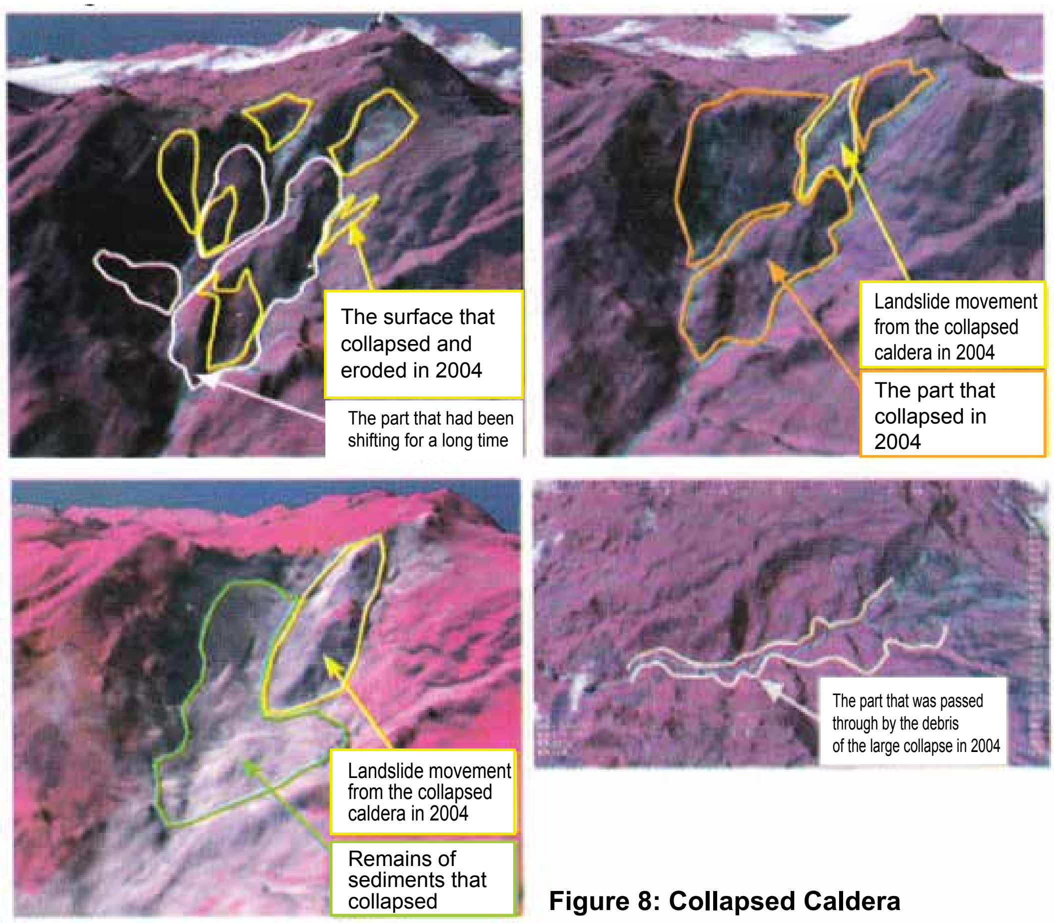


Figure 8: Collapsed Caldera

d. Seawater Intrusion and Coastal Abrasion

Seawater intrusion occurs in the estuary of Jeneberang River, while coastal abrasion occurred in seven regencies and one city, namely Makassar. Overall, the coastal length that experienced abrasion was 122.89 kilometers as shown in the Table 7 below.

Table 7: Coastal Abrasion in Jeneberang River Basin

No	Regency	Name of Beach	Critical Coastal Length (Km)
1	Takalar	Galesong, Cikoang, Parappa, Papo, Saro, Mange-su, Beru, Tamasaju, MuaraJeneberang, Manginda-ra, Takalar, Topejawa, Boddia, Mandi	28.16
2	Bantaeng	Cabodo, Tappanjeng, Borongkalukua, Maricaya, Tompong, Lembang, Lamalaka, Ujung Labbu, Pasoronggi, Mattoanging, Rappoa, TonroKassi, Gallea, Lambocca, Makkaninong	12.58
3	Bulukumba	Ela-Ela, Merpati, Tanaberu, Bintorere, Menara, Lappa'E, PasarCikkeng	11.84
4	Sinjai	Sinjai Beach	3.58

5	Selayar Islands	Bonea, Joo Village, Turungan Hamlet, Benteng Municipality, Bonelohe Village, Maharayya Hamlet, Barugaiya, Parak Hamlet, Appabatu, Baruyya, Bua-Bua, Padang Hamlet, Tongke-Tongke Hamlet	33.89
6	Jeneponto	Batule'leng, Ujung, Binamu, Arongkeke, Pattontongan, Bahari, Tino	22.01
7	Maros	Maros Beach	5.27
8	Kota Makassar	TanjungBunga Beach	5.55
Total			**122.89**

2. WATER RESOURCES MANAGEMENT

2.1. Water Resources Conservation

The water resources conservation aspect of the water resources management in Jeneberang River Basin is broken down into the following sub-aspects:

- Sub-aspect of water resources protection and conservation
- Sub-aspect of water preservation
- Sub-aspect of water quality and water pollution control

Efforts of conservation are carried out through several activities as follows:

a) Maintaining the continuity of water infiltration and water catchment area functions,
b) Controlling the utilization of water sources,
c) Recharging water in water sources,
d) Managing sanitation infrastructures and facilities,
e) Protecting water resources in relation to development activities and land utilization in areas around water sources,
f) Controlling land cultivation in the upstream area,
g) Managing the riparian area of water sources,
h) Rehabilitating forests and lands, and
i) Preserving protected forests, nature reserves and conservation areas

2.2. Water Resources Utilization

The water resources utilization aspect of the water resources management in Jeneberang River Basin is broken down into the following sub-aspects:

- Sub-aspect of water resources administration
- Sub-aspect of water resources provision
- Sub-aspect of water resources use
- Sub-aspect of water resources development
- Sub-aspect of water resources exploitation

Figure 9: Bili-bili Dam

Most of the utilization of water resource potentials in BBWS Pompengan-Jeneberang is for meeting irrigation requirements, which is 82% to 96% of the total requirements as shown in the Table 8 below. Overall, the average irrigation water requirements amount to 91.18% of the total water requirements.

Table 8: Irrigation Water Requirements and Total Water Requirements

No	River Basin	Irrigation Area (Ha)	Water Requirements in 2002		% Irrigation
			Irrigation	Total	
1	Kaluku – Karama River Basin	16,350	437.50	482.60	90.65%
2	Pompengan - Larona River Basin	34,271	749.70	814.40	92.06%
3	Saddang River Basin	93,724	2,397.20	2,522.00	95.05%
4	Walanae - Cenranae River Basin	95,904	2,739.10	2,862.70	95.68%
5	Jeneberang River Basin	99,245	2,538.70	3,079.20	82.45%
Total, Average		**339,494**	**8,862.20**	**9,760.90**	**91.18%**

The water requirements are fulfilled by a variety of water sources, such as lakes, artificial lakes (situ), traditional reservoirs (embung) and primarily by the reservoirs that have been built, as shown in Table 9 below.

Table 9: Dams

No	Dam	Regency	Height (M)	Storage Capacity (x 1,000 M^3)
1	Bakaru	Pinrang	15	5,800
2	Balabono	Soroako	99	32,000
3	Bili-Bili	Gowa	34	375,000
4	Kalola	Enrekang	34	70,000
5	Saomekko	Bone	30	8,200
6	Larona	Luwu	30	600
7	Ponre-Ponre	Bone	55	48,700
8	Karaloe	Jeneponto	73	32,000

2.3. Control of Water Destructive Power

The control of water destructive power aspect of the water resources management in Jeneberang River Basin is broken down into the following sub-aspects:

- Sub-aspect of water's damaging ability prevention
- Sub-aspect of water's damaging ability management
- Sub-aspect of water's damaging ability recovery

a) Flood management

Based on the results of the analysis on flood discharge with 5-year recurrence interval, the watersheds that need to be prioritized in terms of flood control are those watersheds with flood discharge greater than 100 m³/sec. There are 7 of these watersheds, namely Jeneberang, Maros, Bua, Pappa, Tallo, Tangka and Taman Roya.

Flood control consists of both direct and indirect efforts. Direct control is carried out by utilizing irrigation infrastructures, such as embankment construction, river normalization and multipurpose dam construction.

Indirect control is more emphasized on risk management, in addition to critical land rehabilitation in upstream area by means of planting trees.

b) Erosion and sedimentation management

Erosion and sedimentation management is prioritized on controlling the landslide materials of Mount Bawakaraeng and preventing sedimentation in downstream area, especially the Bili-bili Reservoir. Materials from the landslide are estimated to amount to 250-300 million m³. It is estimated that until 2008, as much as 140 million m³ have flown and settled along the Jeneberang River and the surrounding area, and as much as 90 million m³ are still deposited in the upstream area near the caldera. There are still materials in a volume of 145 million m³ that are in an unstable condition and have the potential to cause a collapse.

In order to overcome the problem, a sediment control planning model has been prepared as shown in the following Figure 8 and Figure 9.

Figure 10: Sediment Control Model of Mount Bawakaraeng

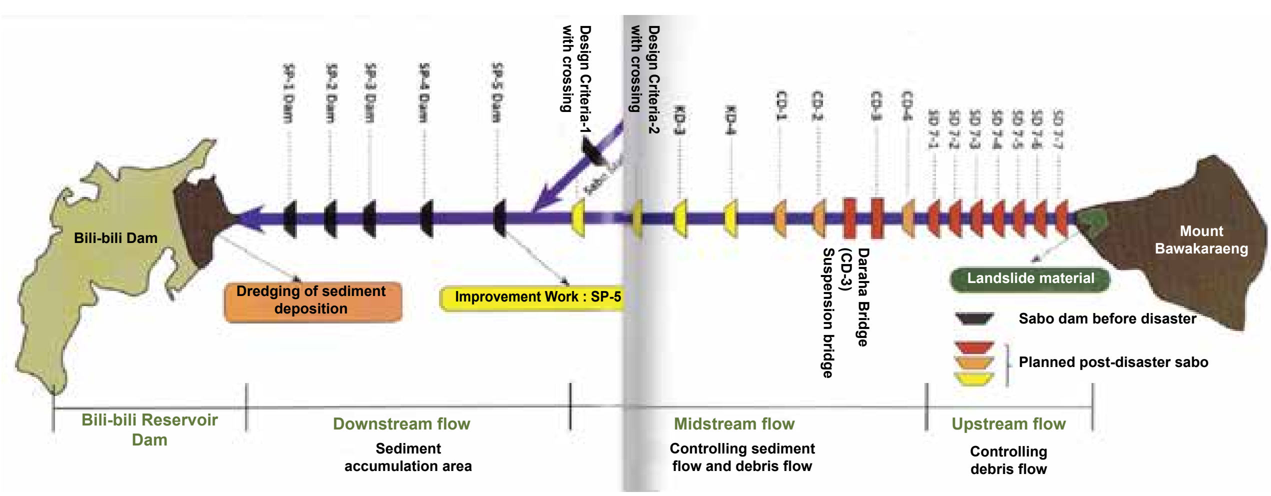


Figure 11: Sediment Control Scheme of Mount Bawakaraeng

- Upstream Management

  The upstream has a very steep slope. At the time ofrain, there is torrential flow and materials glideat a high speed, therefore the damaging ability is very high. A series of seven sabodams (SD) were built to slow down the flow.The existence of sabodam will cause a deposition of material on the upper reaches ofthe construction, and this will lead to a gentle slope of the flow, reduced flow speed, and also reduced damaging ability. These deposits will also stabilize the cliffs of the river channel.

The sabo dams were designed to directly control materials amounting to 1.3 million m³, and indirectly control an amount of 28.2 million m³. Overall, they can control materials amounting to 29.5 million m³.

The constructions of these sabo dams were started by the construction of SD 7-1 in 2005 and the last one constructed was the SD 7-7 in 2011. In addition, as many as 50,000 trees have also been planted on an area of 45 hectares in the upstream to rehabilitate damaged lands.

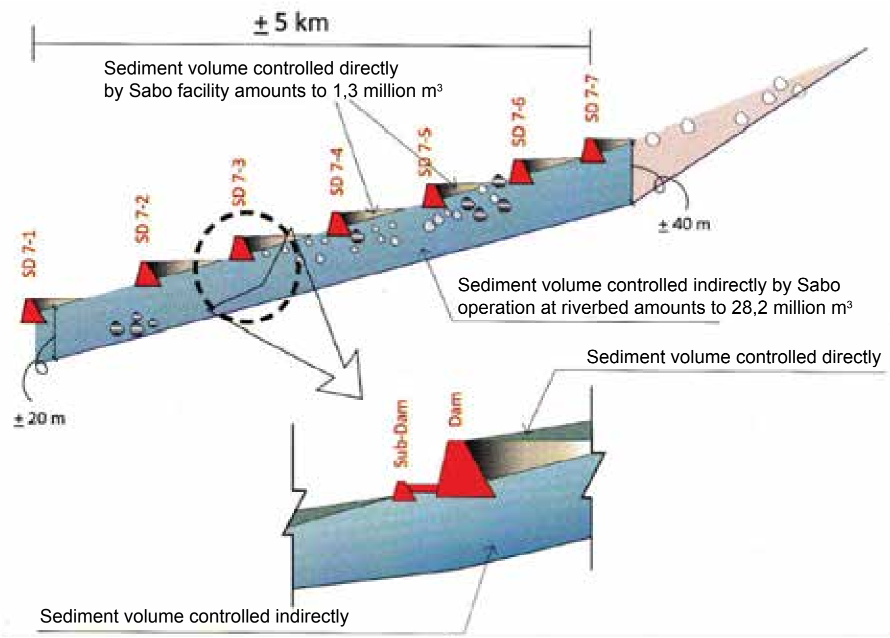


Figure 12: Direct and Indirect Sediment Control

Figure 13: Sabo Dam 7-1 and 7-2
Source: Hazama Co.

Figure 14: Sabo Dam 7-5 and 7-7
Source: Hazama Co.

15

- Midstream Management

The slope at the midstream is still relatively steep, and therefore the flow speed and the damaging ability are still quite high. In this part, 8 consolidation dams (CD or KD) have been built. The main function is to control vertical and horizontal material flows (debris flow, lahar flow) in order to prevent damages and flow deviation.

The consolidation dams were designed to directly control materials amounting to 1.56 million m³, and indirectly control an amount of 48.43 million m³. Overall, they can control materials amounting to 49.99 million m³.

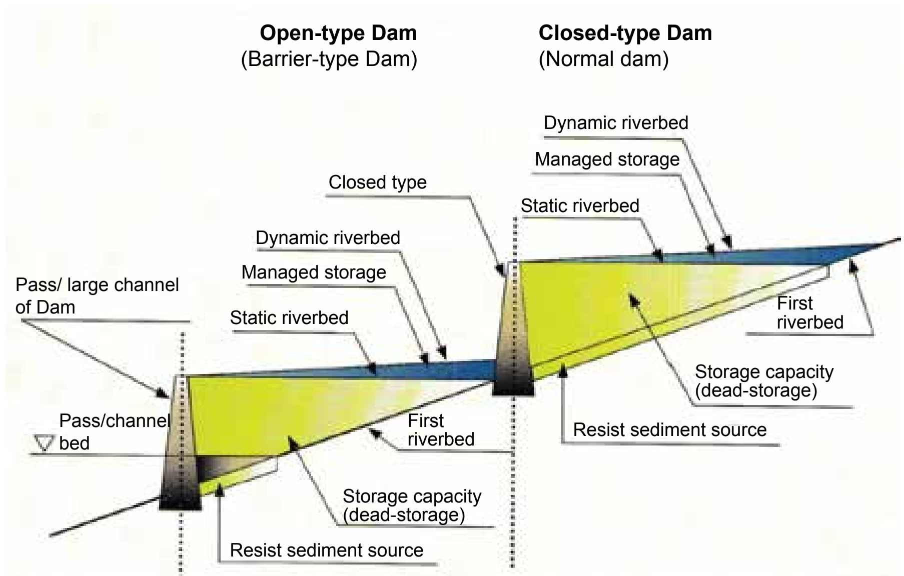


Figure 15: Consolidation Dam
Source: T. Watanabe, 2009

The constructions of the consolidation dams were started in 2007. In addition, 5 units of clean water treatment facilities, 2 crossing roads (in KD-1 and KD-2), as well as 2 suspension bridges (in CD-2 and CD-3), were also built for the local community.

Figure 16: KD-1 and KD-2 that also function as bridges
Photo by SlametWidayadi

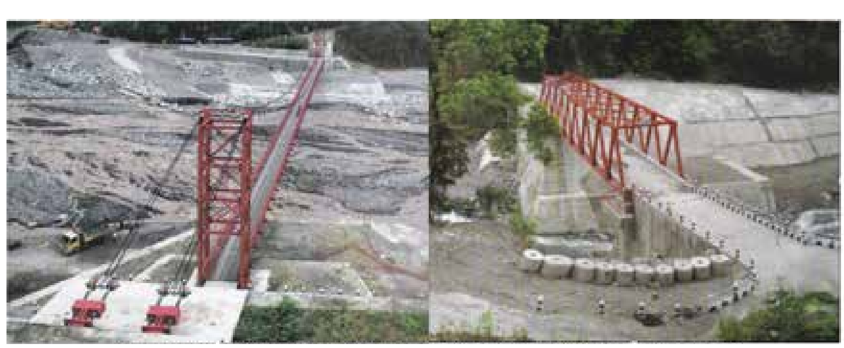


Figure 17: CD-2 and CD-3 equipped with bridges
Photo by Hazama Co & YEC

- Downstream Management

Figure 18: SP-5 before Mount Bawakaraeng landslide
Source: BBWS Pompengan-Jeneberang

Figure 19: SP-5 after Mount Bawakaraeng landslide
Source: BBWS Pompengan-Jeneberang

The slope at the downstream is relatively not too steep. The flow from the upstream, which slope is steeper, will suddenly lose its speed when it enters the downstream part, and it then will release the sediments that it carries, which then causes a deposition. This deposition can spread in many directions if it is not controlled. The area of this deposition is known as an alluvial fan.

Before the landslide of Mount Bawakaraeng, 5 sand pockets (SP) had been built in this part from 1997 to 2001 by the Bili-bili Dam Project. After the landslide, these sand pockets were damaged and the material deposition exceeded the sand pockets' carrying capacities.

Due to this, the BBWS Pompengan-Jeneberang rehabilitated the structures and enlarged their capacities. Mining facilities for sand and other materials were also built to release the materials out of the sand pockets which can then be utilized as construction materials. These five sand pockets have an overall carrying capacity of 1,081,000 m³.

The sediment flow control infrastructures are also equipped with an early warning system as well as a flood and landslide monitoring station in Lengkete Village. In Gowa Regency, clean water infrastructures have been built for the people of Tamalate Village, Parangloe Sub-regency, as shown in the following figure.

Figure 20: Flood and Landslide Monitoring Station in Lengkese Village and Clean Water Infrastructure for the Residents of Tamalate Village, Gowa
Source: YEC

Overall, the distribution of sediments as part of the Mount Bawakaraeng landslide control can be described in the following figure.

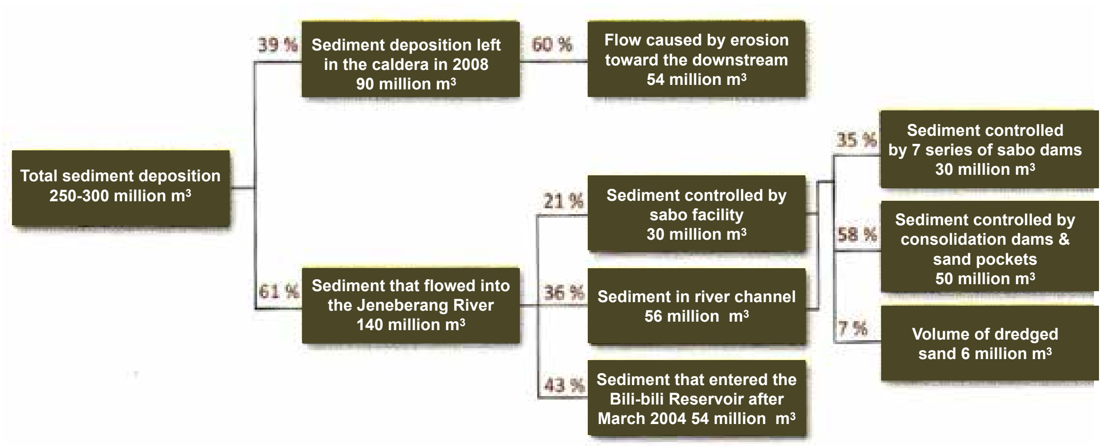


Figure 21: Distribution of Sediments Caused By Mount Bawakaraeng Landslide

c) Seawater intrusion and coastal abrasion control

To prevent seawater intrusion, in 1997, a rubber weir was constructed at a location of 4 km upstream from the estuary. This rubber weir is 210 meters in length and 2.10 meters in height.

In addition, the construction of a reservoir in the estuary of Jeneberang River (long-storage) had also been completed in 2001. Aside from controlling seawater intrusion into the river, the reservoir is also utilized as raw water supply and for drainage channel flushing in the dry season. This reservoir has a length od 4 kilometers, width of 200-300 meters and storage volume of 1,100,000 m³.

Efforts to manage coastal abrasion are carried out in structural as well as non-structural manners. Non-structural effort is done by replanting mangrove trees, while structural effort is done by building coastal cliff protection and reinforcement structures, including:

- Wave breakers,
- Sea walls,
- Gabions, cribs

2.4. Water Resources Information System

The activities carried out in the preparation of water resources information system are:

- Coordinating with BBWS Pompengan-Jeneberang, Watershed Management Office (BPDAS), Water Resources Management Office of South Sulawesi Province, and other relevant offices that are required to follow the norms, standards, guidelines and manuals of information system management.

- Updating data and information periodically as part of the effort to maintain the accuracy of water resources data and information.

- Accessing specific water resources information.

- Coordinating with legal entities, organizations, institutions, and individuals that carry out water resources information management activities.

Figure 22: Socialization and Workshop on Water Resources Information System

As the providers of water resources information, the Regional Government and BBWS Pompengan-Jeneberangare obligated to maintain the accuracy, validity and timeliness of the data and information. With many problems that exist, it is necessary to manage the data and information related to the water resources in thier work areas in an integrated manner.

Various activities of socialization and workshops have been implemented to introduce the website of BBWS Pompengan-Jeneberang managed by the Water Resources Information System (SISDA) Unit to the public and increase the human resources' competency in conducting a fast, precise and accurate water resources data and information management, as well as to realize the availability of easily accessible water resources data and information.

2.5. Community Empowerment and Participation

Agencies related to water resources management at provincial and regency/municipal levels in the work area of BBWS Pompengan-Jeneberang also have to function as data and information providers for the technical implementation unit of national data and information management, which also selects, stores, delivers and distributes the data and information compiled from the water resources managers in BBWS Pompengan-Jeneberang.

Community empowerment, monitoring and involvement in water resources management are generally carried out through the forum of Water Resources Management Coordination Team (TKPSDA) of river basins that have been established, namely:

1) TKPSDA of Pompengan-Lorena River Basin, number of members: 36 people
2) TKPSDA of Saddang River Basin, number of members: 42 people
3) TKPSDA of Walanae-Cenranae River Basin, number of members: 22 people
4) TKPSDA of Jeneberang River Basin, number of members: 32 people
5) TKPSDA of Kaluku-Karama River Basin, number of members: ... people

Other activities that involve the community are land reforestation and rehabilitation carried out through the forum of the National Movement for Water Safeguard Partnership (GN-KPA). These activities are carried out in watersheds with critical lands, such as in Jeneberang Watershed, Tamangroya Sub-watershed in Gowa Regency. These activities are carried out on a regular basis and are coordinated by the work groups established in many places.

Figure 23: GN-KPA Work Group Secretariat

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. Comprehensive Management

The work area of BBWS Pompengan-Jeneberang, especially the Jeneberang River Basin, has a high potential for agricultural development, and this makes the fulfillment of irrigation water requirements as the main priority. The agricultural commodities that are highly important are food crops. Agricultural development is directed toward food sustainability by focusing on increasing the national production capacity for strategic food commodities, namely rice, corns, cassava, sweet potatoes, peanuts, mung beansandsoybeans.

The Mamminasata Region is a National Strategic Region. This region will become a megapolitan area in East Indonesia with rapidly growing industries, and this will certainly accompanied by an increase in household, urban, and industrial water requirements. Efforts to meet the clean water requirement for households, urban areas, and industries are planned to carry out by constructing Bontosunggu Dam, Jenelata Dam, and increasing the capacity of SombaOpu Water Treatment Installation in order to guarantee the availability of raw water amounting to 4.7 m³/sec.

Selayar Islands and Jeneponto Islands are areas with low levels of water fulfullment, and therefore require optimal water resources management. The construction of Kelara, Bontojaya, and Posi dams is expected to help fulfill the raw water requirement for clean water in an amount of 3 m³/sec.

Furthermore, the management of natural lakes and artificial lakes needs to be optimized for their preservation, utilization and exploitation. In the work area of BBWS Pompengan-Jeneberang, there are at least 57 natural lakes and 30 artificial lakes with potentials for development.

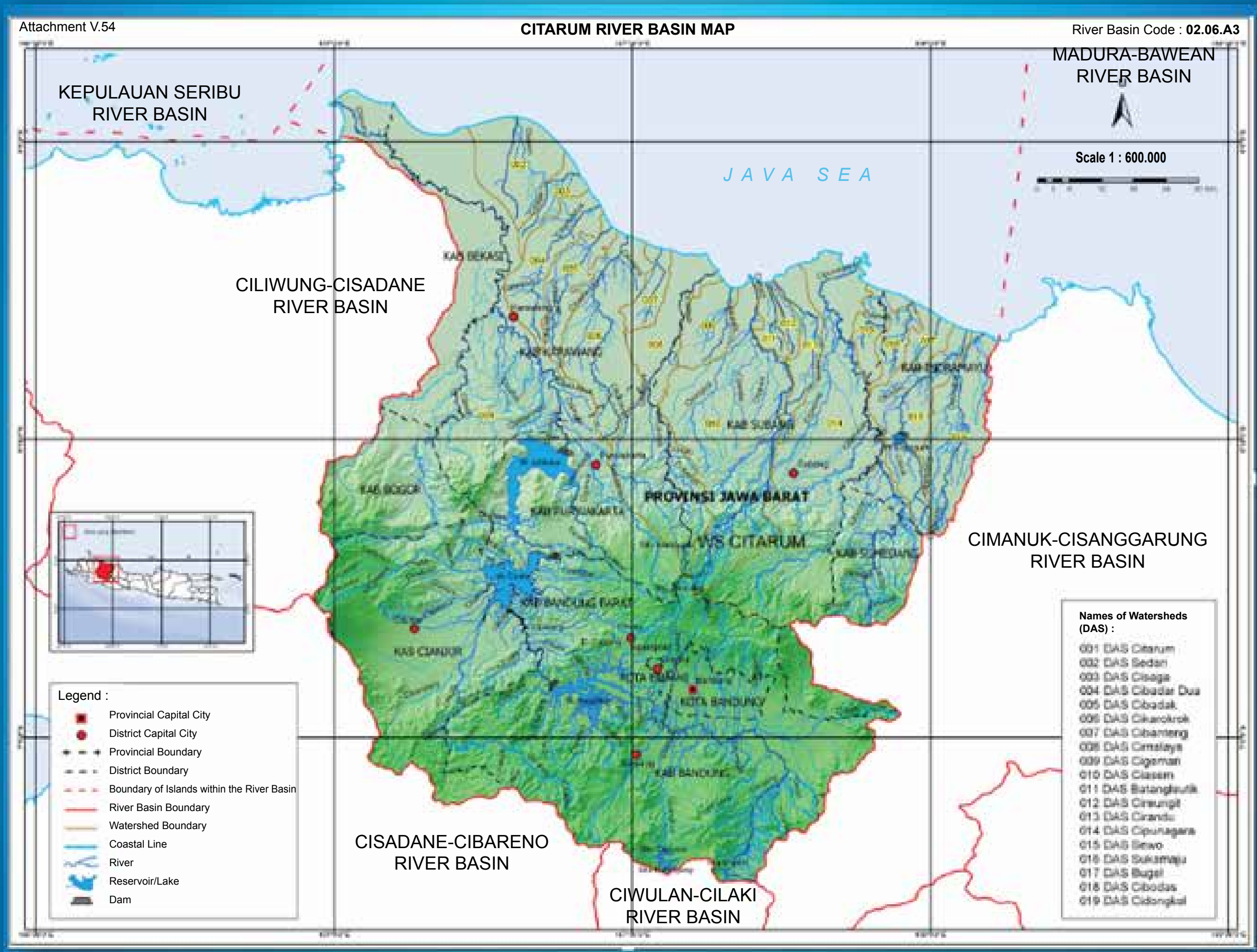
3.2. Implementation Strategy

As has been described in the previous chapter, the work area of BBWS Pompengan-Jeneberang covers 3 provinces, 18 regencies, 3 municipalities, and 3 cross-provincial river basins as well as 2 national strategic river basins, with a total area of more than 60 thousand km².

The river basins management, starting from the preparation of the models and plans (carried out by the TKPSDA in the concerned five river basins) as well as the preparation of their programs, activities and implementations, require various coordination, consultations, socializations, etc., which must involve all stakeholders in all work areas. Meanwhile, with the limitation of the National

Budget (although the Budget Implementation Lists in the past three years have continued to increase), it is necessary to determine the priorities in the programs and activities that are to be implemented, by taking into account the effectiveness and efficiency factors, in addition to social consideration, equality, etc.. Of course, the priorities have to remain within the frameworks of the National Long-Term Development Plan (RPJPN), National Medium-Term Development Plan (RPJMN), Strategic Plan (Renstra), Regional Long-Term Development Plan (RPJPD), Regional Medium-Term Development Plan (RPJMD) and the Regional Government Work Plan (RKPD).

A7. LARGE RIVER BASIN ORGANIZATION OF CITARUM



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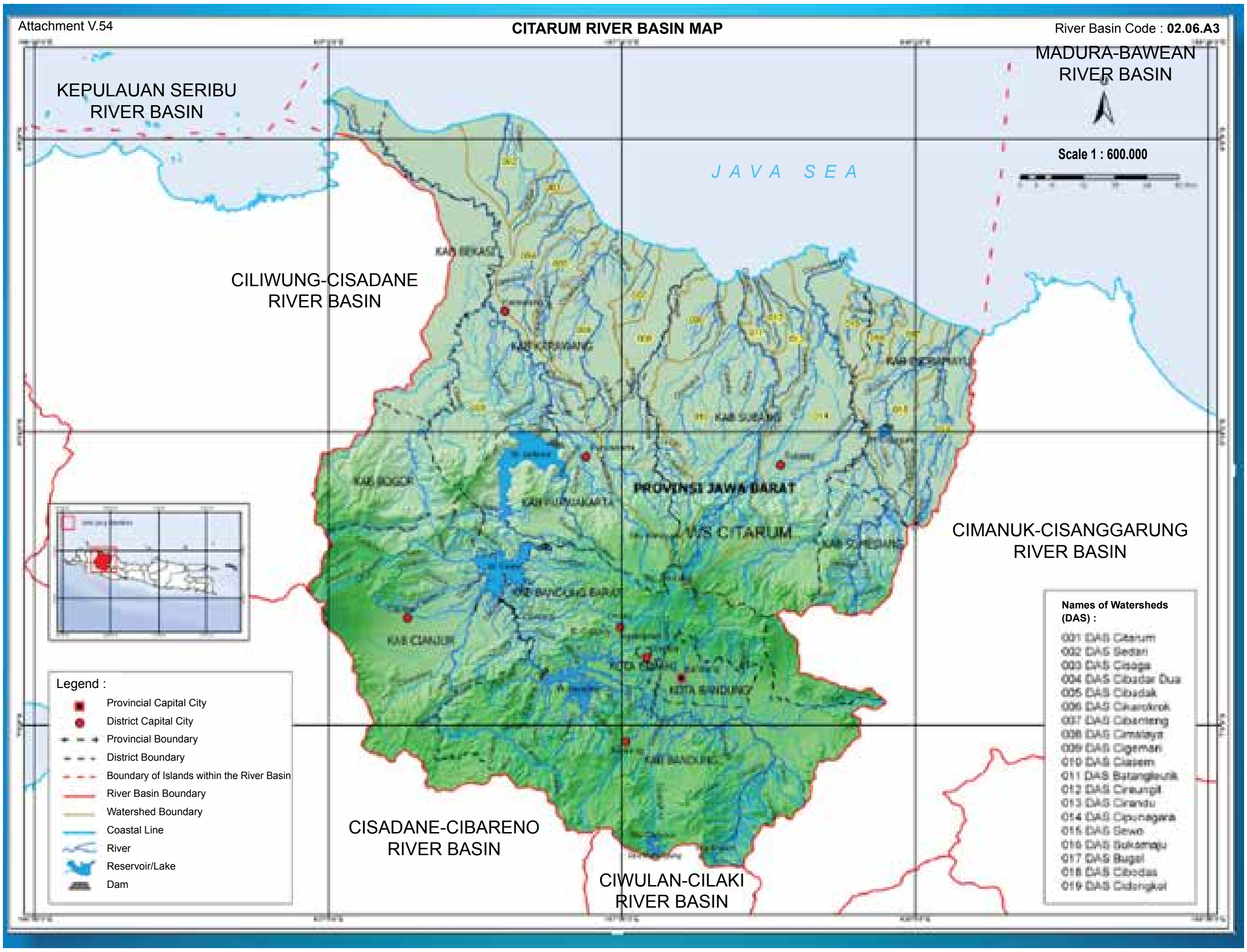


Figure 1: Citarum River Basin

1.1. General Information

Name	:	Balai Besar Wilayah Sungai Citarum
Address	:	Jl. InspeksiCidurianSTA 5600, SoekarnoHatta
Municipality	:	Bandung, 40292
Telephone	:	(022) 7564073
Facsimile	:	(022) 750760
Website	:	
E-mail	:	
Legal Basis	:	Regulation of Minister of Public Works Number 21/ PRT/M/2010 dated December 31, 2010
Work Area	:	Citarum River Basin
River Basin Code	:	02.10.A3
River Basin Classification	:	National Strategic River Basin

1.2. Brief History

1957	:	NationalJatiluhur Multipurpose Project
1965	:	KOPAIRJAT (KomandoProyekPengairanJatiluhur) / Jatiluhur Irrigation Project Command
1967	:	Perusahaan Negara Jatiluhur / State Company of Jatiluhur

1970	:	PERUM OTORITA Jatiluhur (POJ), which included PROSIJAT (Jatiluhur Irrigation Project) as the replacement of KOPAIRJAT
1985	:	Separation of PERUM OTORITA Jatiluhur and PROSIJAT
1987	:	PROSIJAT changed name into BP PSJ (Badan Pelaksana Proyek Serbaguna Jatiluhur) or the Executive Agency forJatiluhur Multipurpose Project. At the time, the organization already had Echelon III-A officials (Decree of Minister for the Supervision of the State Apparatus) and they were proposed to be promoted to Echelon II-B officials.
1994	:	Establishment of Master Project for Citarum River Basin Management, which consisted of the Jatiluhur Multipurpose Project and the Upper Citarum River Improvement and Management Project, consisting of: 1. Citarum Water Sources Management and Flood Control Project 2. Citarum Water Sources Development and Conservation Project 3. Citarum Raw Water Project 4. Citarum Irrigation Project
1999	:	POJ was changed into PerumJasaTirta II (PJT II)
2005	:	Master Project for Citarum River Basin Management changed name into Master Implementer for Citarum River Basin Management Operations
2007	:	Balai Besar Wilayah Sungai Citarum (Large River Basin Organization of Citarum)

1.3. Organizational Structure and Human Resources

The organizational structure of the Balai Besar Wilayah Sungai (BBWS) Citarum was established based on the Regulation of Minister of Public Works Number 11A/PRT/M/2006. The organization is categorized as a type-A large river basin organization which is led by the Head of Organization, assisted by the Head of Administration Department and 3 (three) Heads of Divisions.

The Head of Administration Department is assisted by 3 (three) Heads of Sub-departments, while the Heads of Divisions are assisted by 2 (two) Heads of Sections.

In their operations, they are assisted by 2 (two) heads of workunits, namely the Head of BBWS Citarum Work Unit and the Head of Citarum Non-Vertical Work Unit for Particular Purpose (SNVT).

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

In total, there are 329 employees, consisting of 293 civil servants (156 people with technical educational background and 137 with non-technical educational background) and 36 non-civil servants, with details as shown in the following Table 1:

Table 1: Number of Employees in BBWS Citarum

No	EDUCATIONAL LEVEL	TOTAL
1	S III (Doctoral Degree)	1
2	S II (Master's Degree)	20
3	S I (Bachelor's Degree)	54
4	D III (3-year Associate Degree)	31
5	D I (1-year Associate Degree)	-
6	Senior High School/Equivalent	156
7	Junior High School /Equivalent	12
8	Elementary School	19
Total		**293**

1.4. General Condition of Work Area

Citarum River Basin is the largest river basin in the West Java Province. Geographically it is located at 106° 51’ 36” East Longitude to 107° 51’ 00” East Longitude and 7° 19’ South Latitude to 6° 24’ South Latitude. The river basin covers a total area of 12,000 km², consisting of 13 regency/municipal administrative regions, namely the City of Bandung, City of Cimahi, Bandung Regency, West Bandung Regency, Cianjur Regency, Karawang Regency, Bekasi Regency, Bogor Regency, Sumedang Regency, Purwakarta Regency, Subang Regency, Sukabumi Regency and Indramayu Regency.

According to the Central Bureau of Statistics/Statistics Indonesia (2009), the population in the Citarum River Basin amounts to 15,303,758 persons, with 10 million of them residing in areas along rivers. The number of population that require the services of the Citarum River is approximately 25 million people, including the 10 million people of Jakarta.

The majority of the population resides in the area called the Bandung Basin, which is the area with the highest level of urbanization. The ideal population for this area is between 3 to 4 million people, but the population grows rapidly in this area as shown by the following prediction:

- 2000: 6,178,955 people
- 2005: 6,923,900 people
- 2009: 7,073,527 people
- 2010: 7,867,006 people
- 2015: 9,107,259 people
- 2020: 10,190,304 people
- 2025: 11,382,200 people

Based on the prediction, a new economic region needs to be opened outside the Bandung Basin.

Forest cover is only 26,544ha (11,5%). The erosion rate in the Upper Citarum Watershed is in a very bad condition with an average value of 491 tons/ha/year.

1.5. General Condition of Work Area

Records on rainfall data from 1950 to 1984 obtained from 10 rain gauge stations located in Citarum Watershed show that the average annual rainfall (arithmetic mean) is 2,478 mm. The majority, which is 68% or 1,679 mm, occurs during the rainy season, and the remaining 32% occur in the dry season. Historically, August is the month with the lowest rainfall, which is 90 mm.

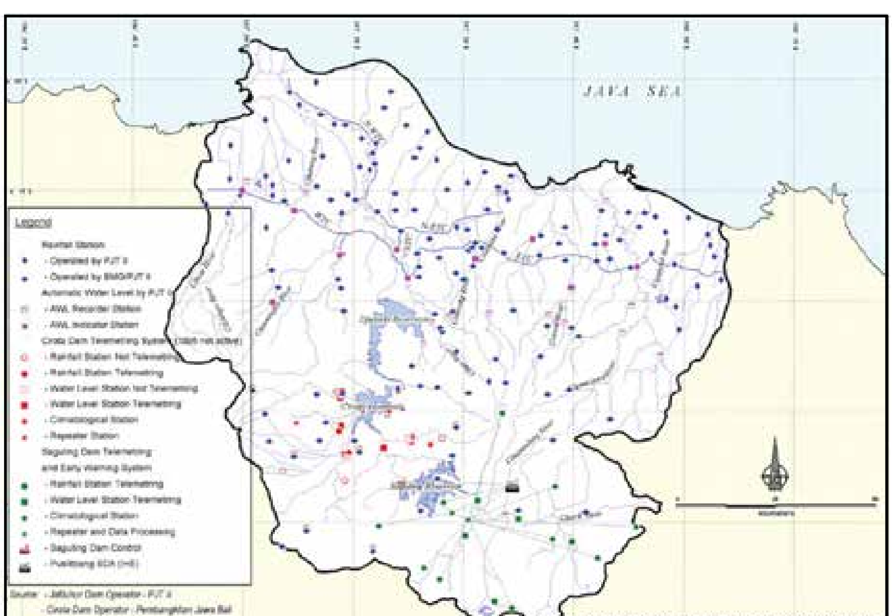


Figure 8 Hydrological Stations in the Project Area

Figure 2: Hydrological Stations

There are many hydrological stations in the Citarum River Basin, including those managed by the managers of dams in this river as shown in Figure 2 above. Some of the stations still have to be operated manually and others are already connected to the telemetering system and data processing, whether for dam operation and maintenance as well as for flood early warning system, such as shown in Table 3 below.

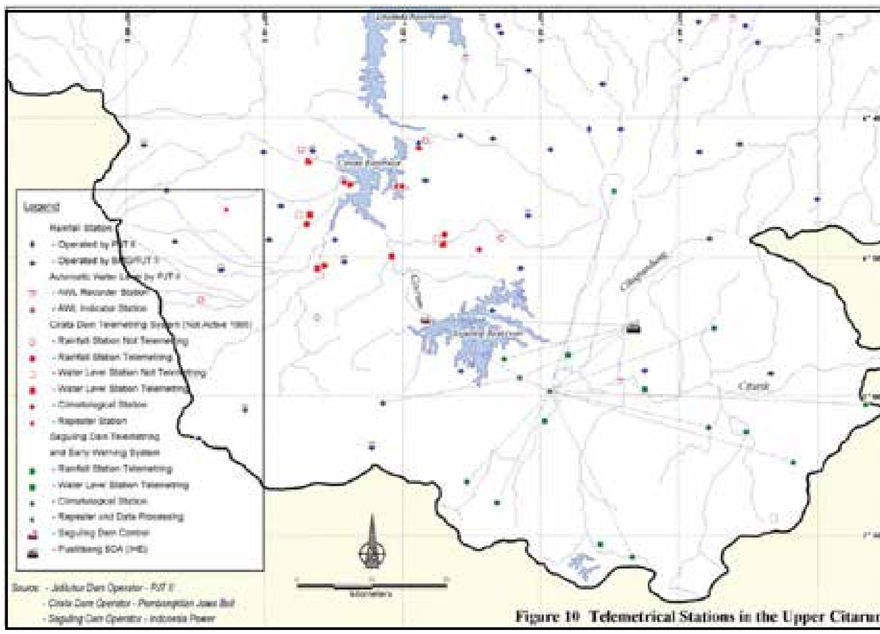


Figure 3: Telemetry Stations in Upper Citarum Watershed

1.6. Watersheds and Rivers

BBWS Citarum stated that it has 13 main Sub-watersheds (or watersheds), while Presidential Decree Number 12 of 2012 has decided that there are 19 watersheds in the Citarum River Basin, as shown in the Table 2 below.

Furthermore, BBWS Citarum stated that it has 21 tributaries, while records show that there are 187 tributaries ranging to the second order.

During the period of 1951 to 1998, the Citarum river discharge in Nanjung Station had experienced drastic changes, which was the increased maximum discharge from 217.6 m^3/sec to 285.8 m^3/sec, while the minimum discharge declined from 6.35 m^3/sec to 5.70 m^3/sec.

Table 2: Watersheds and Sub-watersheds in Citarum River Basin

No	Watershed
001	Citarum Watershed
002	Sedari Watershed
003	Cisaga Watershed
004	Cibadar Dua Watershed
005	Cibadak Watershed
006	Cikarokrok Watershed
007	Cibanteng Watershed
008	Cimalaya Watershed
009	Cigemari Watershed
010	Ciasem Watershed

No	Sub-watershed	Area of Watershed (Km^2)	River Length (Km)
1	Cimahi	32.61	8.22
2	Cibeureum	60.71	11.36
3	Ciwidey	228.36	20.99
4	Cibolerang	60.85	4.99
5	Citepus	36.52	10.98
6	Cisangkuy	280.95	18.80
7	Cigede	145.40	15.42
8	Cicadas	29.71	8.91
9	Cidurian	33.95	8.45
10	Cipamongkolan	42.23	13.79

011	Batangleutik Watershed		11	Cikeruh	190.33	13.78
012	Cireungit Watershed		12	Citarik	257.49	11.50
013	Cirandu Watershed		13	CitarumHulu	363.44	43.85
014	Cipunegara Watershed					
015	Sewo Watershed					
016	Sukamaju Watershed					
017	Bugel Watershed					
018	Cibodas Watershed					
019	Cidongkol Watershed					

According to Untung Haryanto, based on the Catalogue of Rivers, 1995, 1997, 2000, 2002; the results of recording in the Nanjung Station showed a maximum discharge of 455 m^3/sec, and a minimum discharge of 5,4 m^3/sec.

These changes were obviously due to the increasingly damaged hydrological condition of the watersheds.

1.7. Issues

a) Critical Lands

Figure 4: Very Critical Land

The Decree of Minister of Forestry Number SK.328/Menhut-II/2009 regarding the Establishment of Priority Watersheds as Part of the Medium-Term Development Plan of 2010-2014 has established the Citarum Watershed as one of the 108 critical watersheds.

There are at least 26,437 hectares of land which conditions are categorized as very critical, as shown in Table 3 below. This condition leads to runoff amounting to 3.6 million m^3/year.

Table 3: Categories and Areas of Critical Lands

No	Land Category	Area (Ha)	Percentage (%)
1	Very Critical	26,437	1.36
2	Critical	115,988	7.64
3	Rather Critical	273,880	21.69
4	Potentially Critical	468,255	45.01
Total		**884,560**	**100.00**

Source: BP DAS Citarum-Ciliwung

The critical lands are generally found in the upper Citarum, especially in the Cirasea, Cisangkuy, Ciwidey, Ciminyak, Cihaur, Cikapundung and Citarik sub-watersheds, as seen in the following Figure. It can be seen that the sedimentation that occurs in those locations can reach 1,755,517 tons/year.

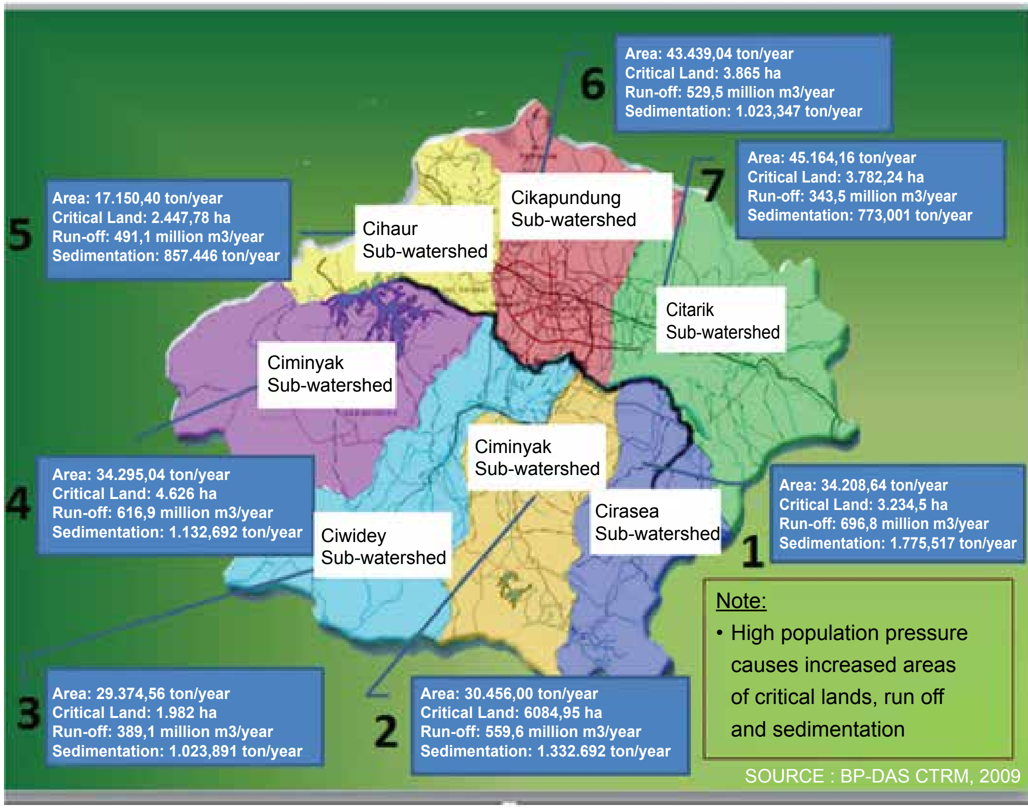


Figure 5: Critical Lands in Upper Citarum

Figure 6: Sedimentation in River Channel

The percentage of lands with heavy and very heavy erosions (>180 tons/ha/year) is 31,4% of the total area of Citarum River Basin. The erosions that occurred at the upper part of Citarum produced an average sedimentation of 8.20 million m³/year in Saguling Reservoir. In addition, the erosions also caused siltation and river channel narrowing as seen in Figure 6.

b) Floods and Droughts

Critical land condition is the main cause of erosion. Furthermore, erosion leads to sedimentation and this sedimentation leads to siltation and narrowing of river channels, irrigation canals, and also reservoirs. On the other hand, land damages have caused increased flow coefficient and in time, all these will give rise to floods and droughts.

Several major floods in Bandung and the surrounding area occurred in 1931, 1945, 1977, 1982, 1984, 1986, 1998, and 2005. The Citarum flooding occurred not only in the downstream but also in the midstream and the upstream.

Figure 7: Flooding in Upper Citarum

Flooding occurred in at least 7 regencies/municipalities, originating from the Citarum River and some of its tributaries, covering a total area of more than 18,460 ha, as seen in Table 4 below.

Table 4: Flood Inundation Areas

No	Regency/Municipality	River	Area of Inundation (Ha)
1	Bandung Regency/Municipality	Upper Citarum	7,500
2	Bekasi/Kerawang	Lower Citarum	1,000
3	Karawang/Subang	Cilamaya	2,400
4	Subang	Ciasem	900
5	Subang	Cipunegara	2,440
6	Subang	Cigadung	no available data
7	Indramayu	Cilalanang	4,000
8	Karawang/Indramayu	Pantai Utara (North Coast)	no available data
9	Purwakarta	Cikao	20

Meanwhile, areas that experience flooding in the rainy season also experience droughts in the dry season, as shown in the following Figure 8.

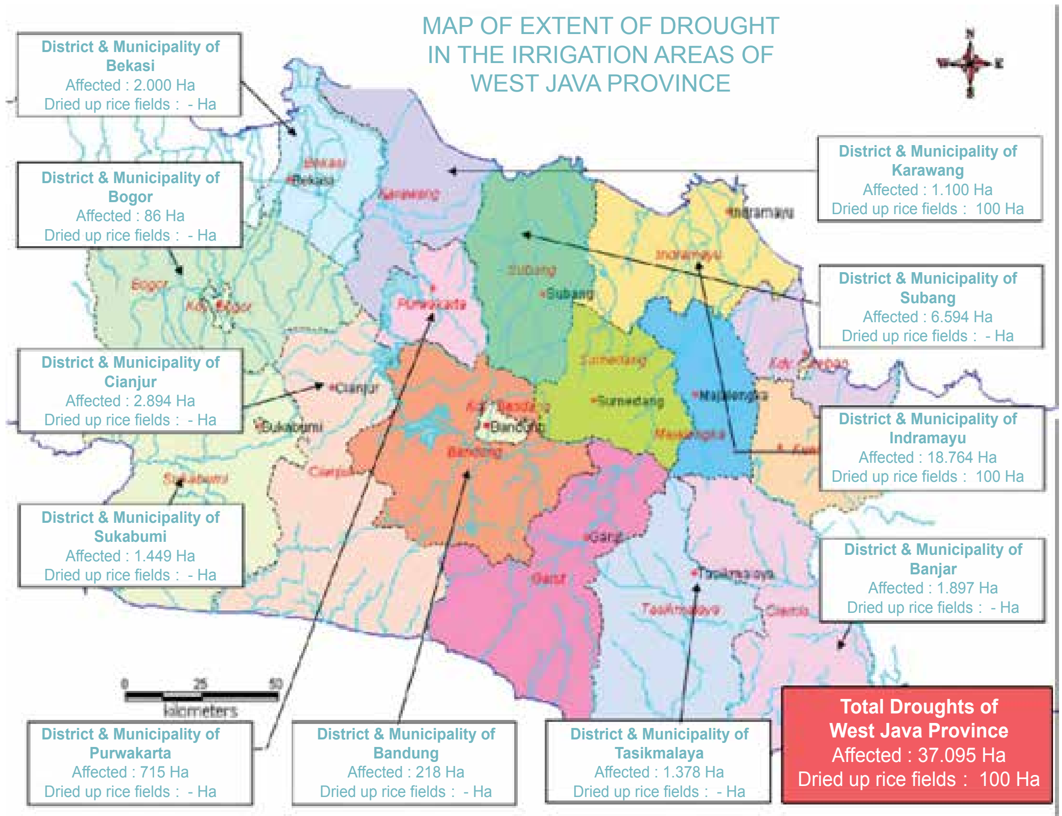


Figure 8: Drought Areas

c) Land Subsidence

Land subsidence in Bandung Basin reaches 4 to 5 cm per year. At present, groundwater abstraction is still under the ideal limit for groundwater abstraction, in which current abstraction is still 25%. However, for several locations in Bekasi-Karawang Groundwater Basin, Subang Groundwater Basin and Batujajar Groundwater Basin, groundwater abstraction has exceeded the ideal limit for groundwater abstraction. Although at the moment groundwater abstraction in the Bandung-Soreang Groundwater Basin is still under the ideal limit for groundwater abstraction (still at 27%), groundwater abstractions in several places such as in Majalaya, Ranca Ekek, Dayeuh Kolot, Leuwi Gajah etc., have exceeded the ideal limit for groundwater abstraction. In these areas, there have been serious decline in groundwater level and land subsidence. Groundwater abstraction through deep wells is frequently carried out in industrial areas, while inhabitants abstract water from shallow wells.

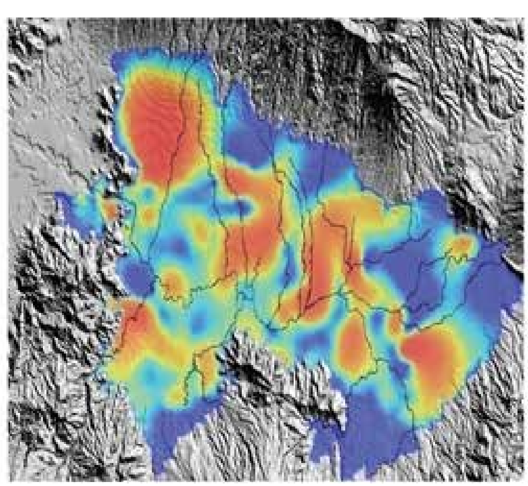


Figure 9: Land Subsidence in Bandung Basin

d) River Pollution

River pollution occurs due to the entering of domestic waste and industrial waste into the river channel, whether deliberately or carried by runoff during the rain. The garbage amounts to 500,000 m^3/year. Those that are not accommodated will enter the drainage system and eventually enter the river.

Figure 10: Pollution by Garbage and Industrial Waste

The Citarum Watershed Forum in West Java released information stating that as many as 1.400 industries dispose their liquid waste into the Citarum River. From the thousands of these industries, there are waste of hazardous and toxic substances disposed during nighttime especially when it rains.

A research conducted in 2007 revealed that the status of Citarum's water quality is at the pollution index of D, which is heavily polluted. The Regional Environmental Management Agency (BPLHD) of West Java, in its studies that were carried out three times a year, found contents of nitrite ($NO2$), lead (Pb), chlorine (Cl), phosphate ($PO4$), zinc (Zn), boron (B), copper (Cu), and sulfate ($SO4$) that exceeded the threshold.

e) Settlement Development

At present, the population in the Bandung Basin has exceeded 7 million people, while the ideal number of population in the Bandung Basin is only 3 to 4 million people. The number is predicted to increase to 10,190,304 people in 2020. This condition has driven the people to exploit space, lands, and water resources which eventually will give rise to many new problems.

The following Figure 11 shows how extensive the pressure is that is caused by excessive population, leading to a density level that reaches more than 200 people per hectare.

It is necessary to open up new settlement and economic regions outside the Bandung Basin.

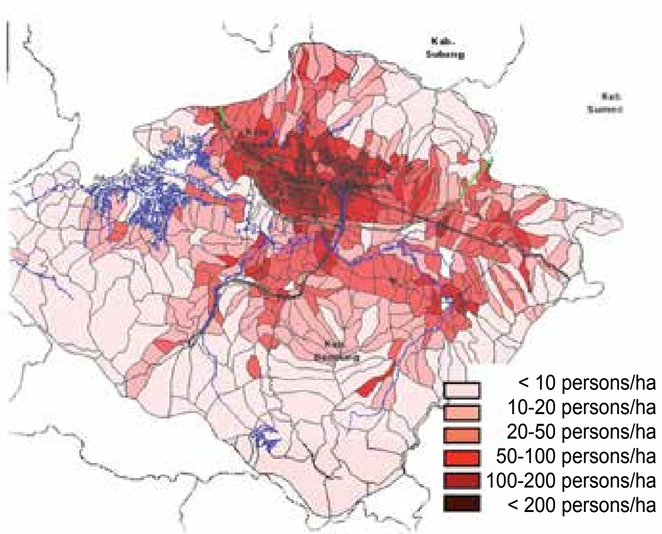


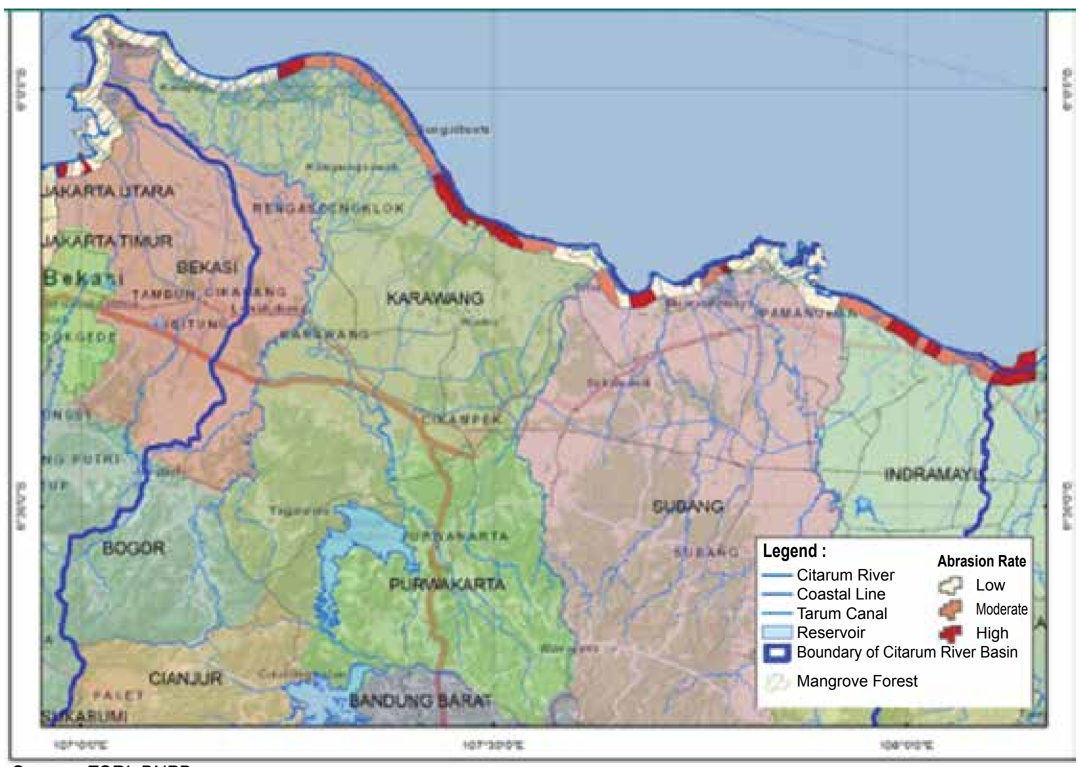
Figure 11: Population Pressure in Bandung Basin

f) Coastal Abrasion

Coastal abrasion in lower Citarum occurred both by nature and by community behavior. Ocean currents and waves are the causes of erosion and also sedimentation at beaches. Coastal sand mining carried out by some of the community and coastal land clearing which turned swamp areas and mangrove forests into fishpond areas exacerbated the coastal abrasion.

Areas that experience coastal erosion at an alarming rate include the Tirtajaya Regency, Cibuaya and Pedes Sub-regency in Karawang Regency, Pusakanagara Sub-regency, Pamanukan Sub-regency and Legokkulon Sub-regency (Subang), Sukra Sub-regency and Kandanghaur Sub-regency in Indramayu Regency.

E. Sri from BPNB categorizes the coastal damages and abrasion rates in Lower Citarum into three groups, namely Low, Moderate, and High, as seen in Figure 12 below.



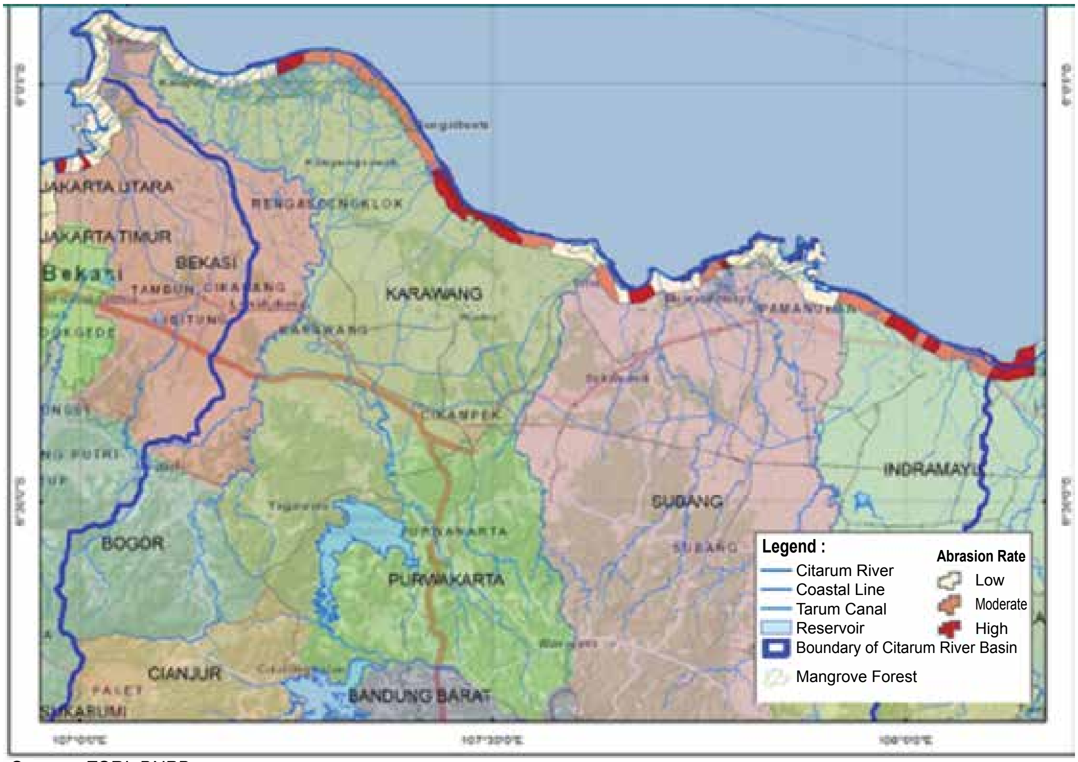
Source : ESRI, BNPB

Figure 12: Coastal Abrasion Rates in the North Coast of Citarum Watershed

2. WATER RESOURCES MANAGEMENT

2.1. Water Resources Conservation

Water resources conservation is primarily carried out by rehabilitating critical lands according to the target and priority as shown in the following Table and Figure 13.



Source : ESRI, BNPB

Figure 13: Critical Land Rehabilitation Priorities

The types and numbers of structures as well as the target areas can be seen in the following Table 5.

Table 5: Land Conservation Structures

No	Civil Structure	Total	Land Category
1	Check Dam	907	RC C VC
2	Detention Dam	109	RC C VC
3	Infiltration Well	1.7	PC RC
4	Gully Plug	219	C VC
5	Ridge/Bench Terrace		RC C VC
6	Blind Ditch		C VC

Note: RC = Rather Critical, C = Critical, VC = Very Critical, PC = Potentially Critical

Table 6: Targets of Critical Land Management

No	Regency	Target of Management		Total (Ha)
		Inside Forest Area	Outside Forest Area	
1	Bandung Regency	36,914	80,786	117,700
2	West Bandung Regency	40,486	79,438	119,924
3	Bekasi Regency	2,062	36,501	38,563
4	Cianjur Regency	30,018	91,873	121,891
5	Indramayu Regency	1,727	6,639	8,366
6	Karawang Regency	11,249	146,402	157,651
7	Bandung Municipality	33	2,274	2,307
8	Cimahi Municipality	-	606	606

9	Purwakarta Regency	14,270	59,912	74,182
10	Subang Regency	18,341	149,130	167,471
11	Sumedang Regency	9,319	27,866	37,185
	Total	**164,419**	**681,427**	**845,846**

The implementation of vegetative conservation in forest areas is carried out by the Centre for Natural Resources Conservation (BBKSDA), PT Perhutani, and the Regency/Municipal Offices of Forestry, while conservation outside forest areas is done by the Offices of Forestry together with the communities and supported by the private sector, such as by PT KTI and assisted by for instance, PT BUMN Hijau Lestari.

Figure 14: Check Dam Construction and Artificial Lake (situ) Rehabilitation

The implementation of mechanical conservation in river channels and tributaries is carried out by BBWS Citarum, and conservation outside river channels is carried out by the Offices of Forestry.

In addition, BBWS Citarum also conducts rehabilitation on several artificiallakes (situ), such as seen in Figure 14 above.

2.2. Water Resources Utilization

Until today, only 60% of Citarum's total water resource potentials have been utilized. The remaining 40% have not been utilized and are just wasted into the sea. The utilization is mostly for irrigation, which amounts to 84% and for drinking water requirement for Jakarta amounting to 6%, as shown in Figure 15 below.

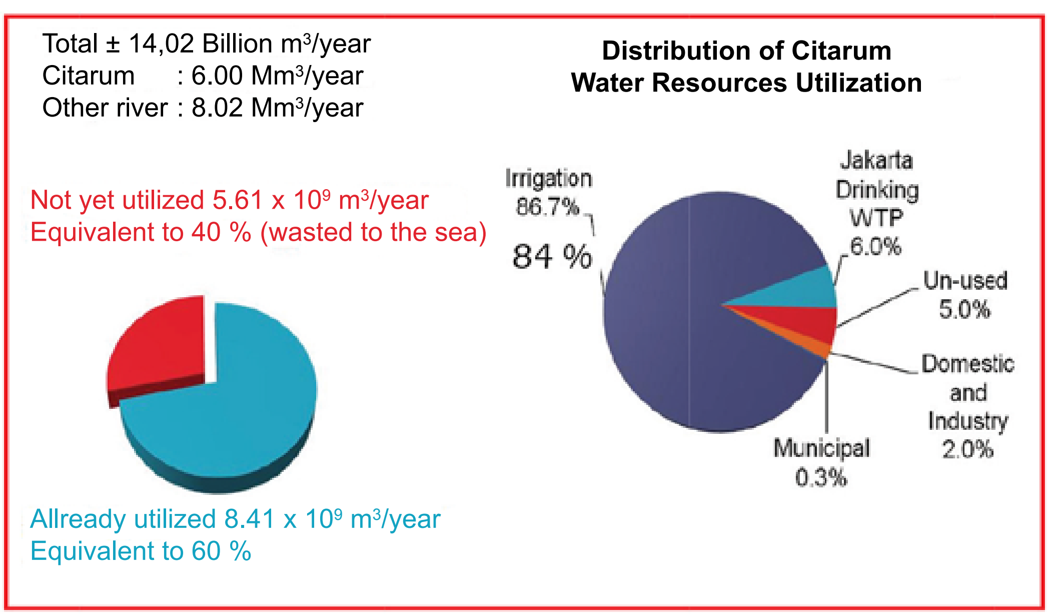


Figure 15: Water Resources Utilization

In order to increase the water resources utilization and also to anticipate the requirements in 2030, several efforts have been planned, including a plan to build several dams. There are at least 18 locations for potential dams. Eight of them deserve to be prioritized, namely Sadawarna, Ciwidey, Cimeta, Sukawarna, Cikapundung, Citerik, Santosa and Cibantarua, as shown in Figure 16 below.

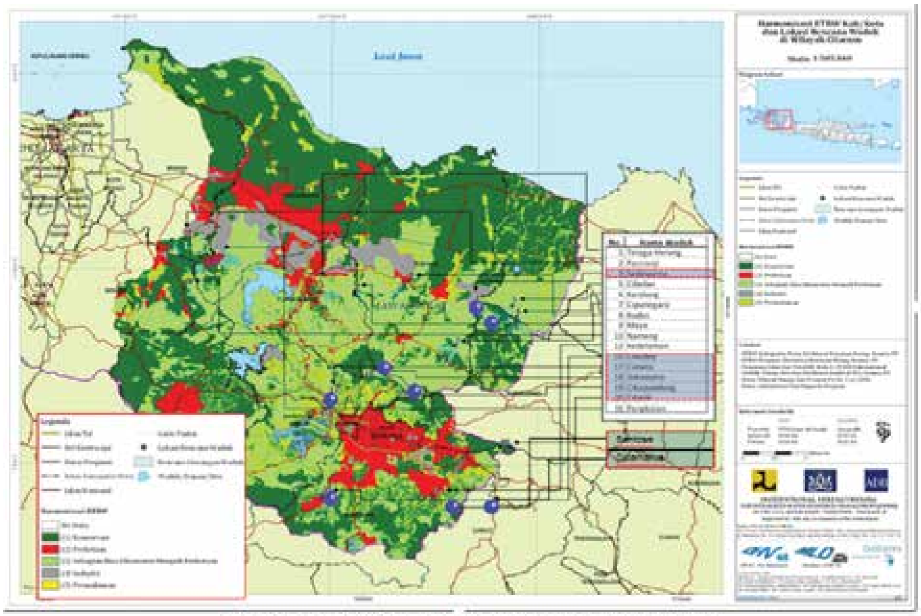


Figure 16: Locations of Planned Reservoirs

The increase of water resources utilization covers for all requirements, which are drinking water, industrial water, irrigation including fisheries and traditional fishponds as well as for encouraging the development of water energy in the form of mini-hydro and micro-hydro power plants.

In addition, it is also necessary to increase the efficiency of water usage, including irrigation, which efficiency is targeted to increase from 55% to 65%.

The water of artificiallakes (situ), field reservoirs or traditional reservoirs (embung) that have been rehabilitated as part of conservation can also be utilized for raw water and local irrigation.

These efforts also need to be accompanied with efforts to increase the efficiency of groundwater utilization and management, such as:

- Building monitoring wells as part of management monitoring and evaluation,
- Building recharge wells,
- Limiting and reducing the granting of groundwater abstraction permit, particularly for industries, especially in Bandung-Soreang Groundwater Basin, Bekasi-Karawang Groundwater Basin, and Subang Groundwater Basin as well as areas which are already provided with clean water,
- Enforcing law against illegal abstractions and abstractions that exceed the limit set in the permit,
- Changing clean water supply from runoff to existing water potentials.

2.3. Control of Water Destructive Power

Control of water destructive power can be categorized as follows:

a) Emergency Management of Flood Infrastructures

Figure 17: Emergency Management

Emergency management is carried out for work that is not or has not been programmed in the Budget Implementation List (DIPA) or that is urgent in nature, such as repairing damages caused by flooding or protecting against the threat of flooding.

Emergency management works that have been carried out include:

- Rehabilitation of collapsed embankments (965 meters in length)
- Repair of critical embankments (16.600 meters in length)

b) Permanent Management of Flood Infrastructures

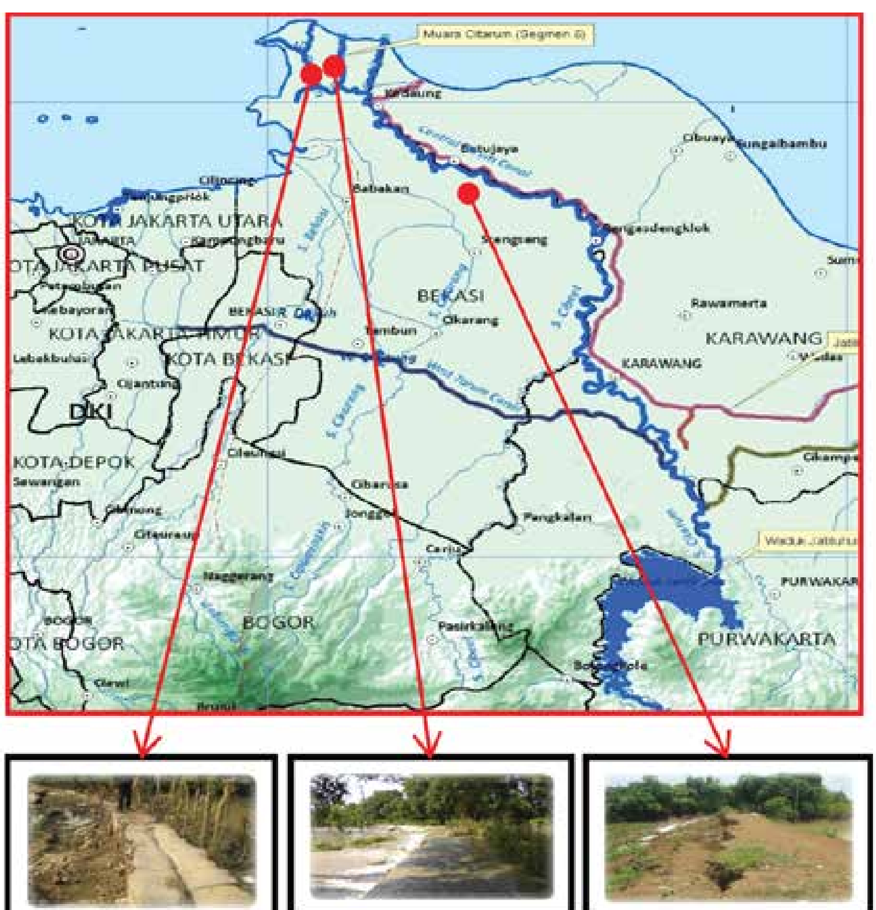


Figure 18: Permanent Management

- Embankment:
    - Embankment rehabilitation from Bojong Village to Gembong Estuary (154 km long)
    - Construction of new embankment between Walahar and Bojong Village
    - Construction of embankment and check dam in Cibeet River

- Dredging or normalization of Upper Citarum River and Bungin River

c) Protection against Coastal Abrasion

Protection against coastal abrasion is done by using vegetative and structural methods. Protection by vegetative method is carried out by maintaining mangrove forests and replanting mangrove for coastal protection. Protection by structural method is carried out by building coastal protection and reinforcement constructions, such as wave breakers, sea walls, gabions, etc..

Figure 19: Management of abrasion in Indramayu Beach and PondokPutri Beach, Subang Regency

d) Landslide Management

- Vegetative Efforts
    - Dryland farming
    - Reforestation by using types of trees which roots can strengthen the resistance to landslides
    - Covering of open slope surfaces with grass

- Structural Efforts
    - Construction of drainage ditches to reduce water infiltration and slope erosion,
    - Slope reinforcement by covering the surface with pavement layer or river stone masonry
    - Construction of bench terraces

- Non-structural Efforts
    - Provision of educative information for the community on landslide/potential landslide locations and regulation concerning the restriction of constructions around landslide-prone areas.

Figure 20: Landslide Management by Vegetative, Structural, and Non-Structural Methods

2.4. Water Resources Information System

Information and secondary data on Citarum River's water resources that are managed by BBWS Citarum can be found and downloaded from the following websites:

http://bbwscitarum.pdsda.net/ or http://www.citarum.org

Information and data from Citarum's hydrological stations are managed by various parties according to their usage, such as PJT II for the management of Jatiluhur Reservoir, PT PLN for the management of Cirata Reservoir and Saguling Reservoir, Center for Water Resources Research and Development, Office of Water Resources Management, etc..

The information is also utilized for flood alertness.

Several Water Resources Information System (SISDA)-related matters found in the Citarum River Basin include:

- Databases in Water Resources Information System network are not yet integrated;
- Some SOPs for the updating of the Water Resources Information System, monitoring and evaluation have been compiled, but the implementation has not been optimal and still need to be completed;
- The Water Resources Information System has not been used as a tool in planning and budgeting.

2.5. 2.5. Community Empowerment and Participation

Community empowerment, monitoring and involvement in Citarum River Basin's water resources management are carried out through several forums such as the Water Resources Management Coordination Team (TKPSDA), National Movement for Water Safeguard Partnership (GNKPA), Movement for Forest and Land Rehabilitation (GNRHL) and so on.

Several physical activities that have been carried out by the GNKPA include rehabilitation, operation and maintenance as well as conservation in Situ Jungkur, Cikalong, Nagrog, Sukamelang, Kumpay, Cibogo, etc., which are widely spread as shoen in the figure below.

Several matters related to the empowerment and participation increase of the community and the business sector which are found in 1 Ci River Basin:

- The performance of the institutions in charge of water resources management is still not maximized, and there is overlapping as well as unequal assignment of roles and responsibilities;
- Stakeholders have not been playing an active role and therefore still require support from the Government;
- The potentials of community roles and women roles in water resources management need to be strengthened.

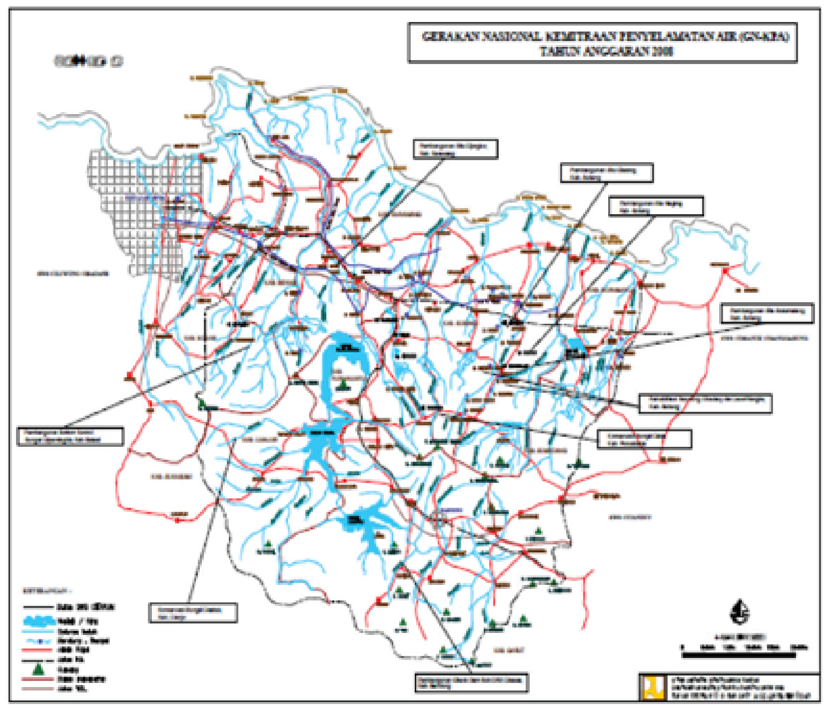


Figure 21: GNKPA Activities in 2008

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. Comprehensive Management

The Citarum River Basin is considered as a national strategic river basin due to several reasons, such as because there has been a great amount of investment by the state for the river basin and there are many national interests that come from the area such as electrical energy and even drinking water for Jakarta mostly still relies on the water of Citarum. On the other hand, the population pressure in Citarum River Basin is also very great, which brings impacts on the water resources management aspect.

In order to overcome the many problems caused by the high population pressure, it is necessary to conduct spatial planning (zonation) and distribution of activity centers so that there is no overload in certain regions only.

3.2. Comprehensive Management

Considering the strategic value of Citarum River Basin for the national interest, all of its issues have been studied intensively through various activities such as:

- Integrated Citarum Water Resources Management Project (ICWRMP)
- Integrated Citarum Water Resources Management Investment Project (ICWRMIP) or also known as the Citarum Roadmap & Investment Program.

Based on the results of those studies, the BBWS has established the Strategic Plan of 2009-2014 which includes 5 programs, namely:

a) Development, management and conservation of rivers, lakes, and other water sources;

b) Development and management of irrigation networks, swamps, and other irrigation networks;

c) Flood control and coastal protection;

d) Raw water provision and management;

e) Implementation of state government leadership.

At present, studies are being prepared as part of the compilation of the Citarum River Basin Management Plan through an activity supported by ADB and the Government of the Netherlands, namely the Institutional Strengthening for Integrated Water Resources Management (IWRM) in the 6 Ci's River Basin Territory.

In order for water resources management to be optimal, the water resources information system needs to be integrated, which concerns hydrological database that includes rainfall, flow condition, sediment content, water level, and flow in extreme conditions such as flood and drought, hydro-meteorological database as well as database and information on groundwater potentials and aquifer conditions.

The development of hydrological database needs to be improved to real time in selected locations which will significantly affect water resources management by adding automatic equipment networks such as AWLL and ARL. The development of geo-hydrological information system network in every groundwater basin should be integrated with the hydrological information of surface water.

The hydrological and geo-hydrological database can facilitate the planning of utilization in every water regency, while water resources information through the system that is going to be built will be able to provide warning on drought and flood and the tendencies for drought or flood.

Potential development of water resources information system includes the technology and addition of equipment, preparation of human resources in the three elements as well as the development of an integrated water resources information system management institution.

3.3. Implementation Strategy

At present, the Institutional Strengthening for Integrated Water Resources Management (IWRM) in the 6 Ci's River Basin Territory has prepared a matrix for the Operational Policies for Water Resources Management in Citarum River Basin.

In the Matrix, the following have been put in details:

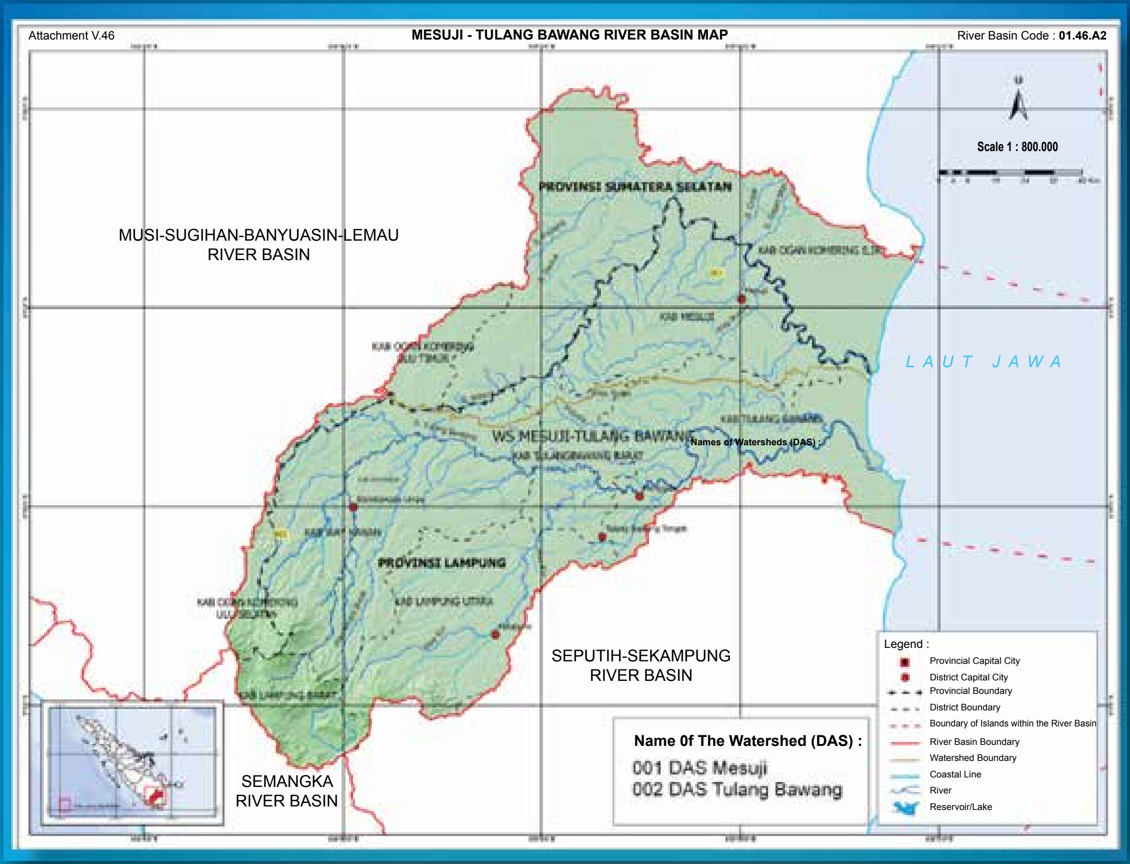
- Short-term Strategy (2011-2015);
- Medium-term Strategy (2011-2020) and
- Long-term Strategy (2011-2030).

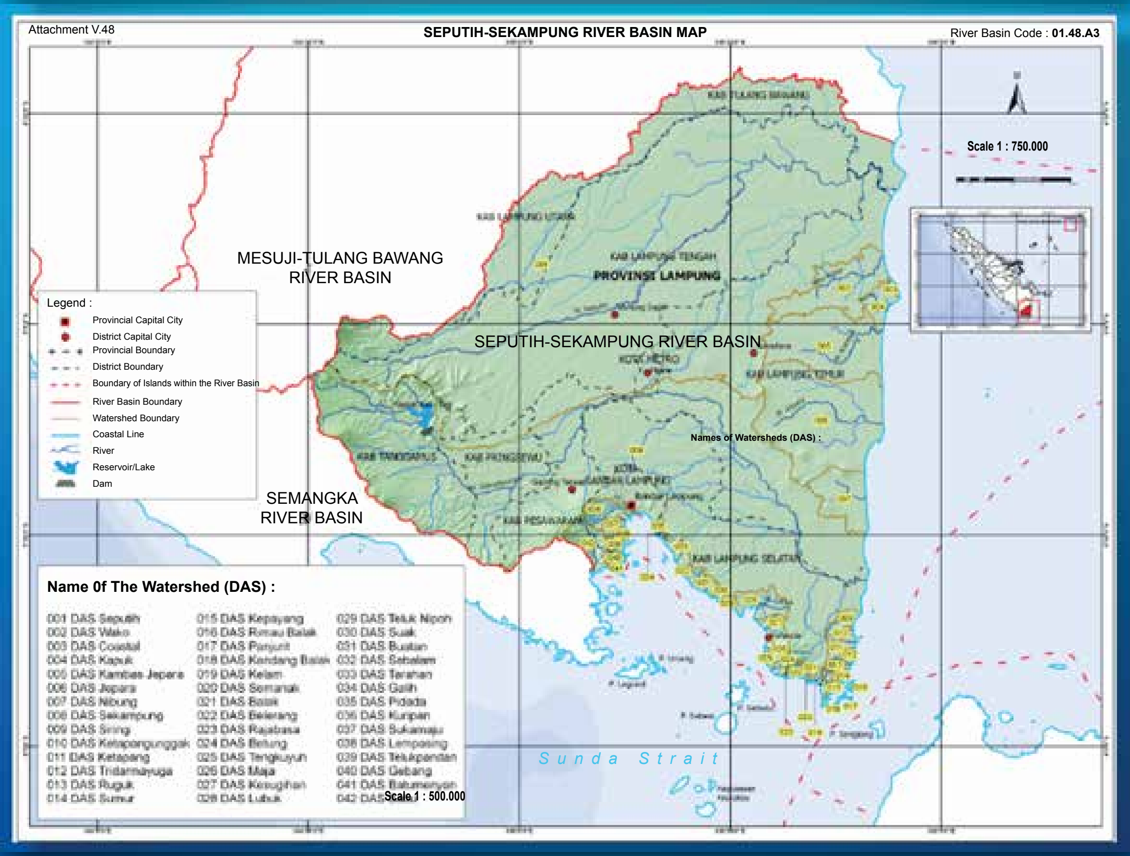
The Operational Policies for Water Resources Management in Citarum River Basin cover 5 (five) aspects, namely:

- Water Resources Conservation
- Water Resources Utilization
- Control of Water Destructive Power
- Water Resources Information System
- Community and Business Sector Empowerment and Participation Improvement

Other than the five aspects, the spatial planning and institutional aspects are also included in the discussion.

A8. LARGE RIVER BASIN ORGANIZATION OF MESUJI-SEKAMPUNG





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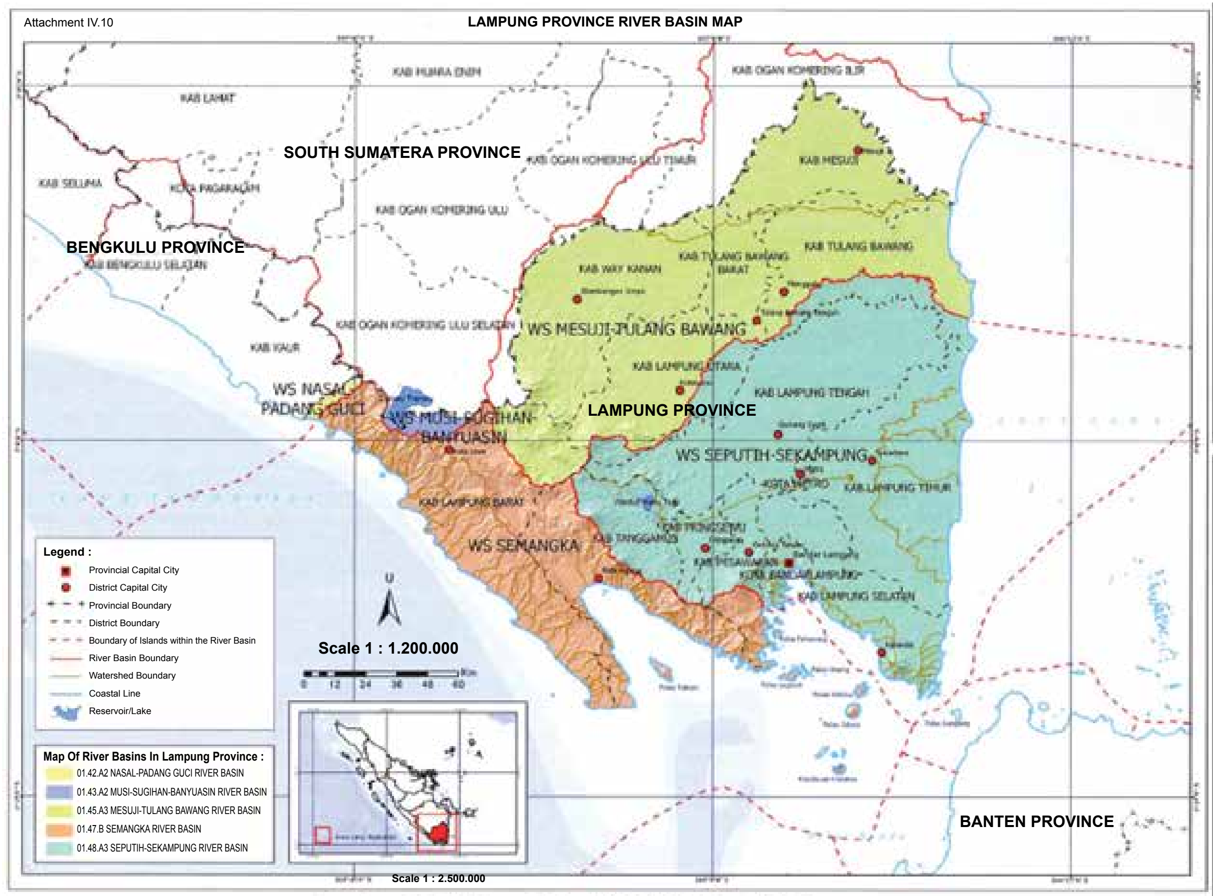


Figure 1: Work Area of BBWS Mesuji-Sekampung

1.1. General Information

Name	:	Balai Besar Wilayah Sungai Mesuji-Sekampung
Address	:	Jl. GatotSubroto No. 57, Garuntang
Municipality	:	Bandar Lampung - 35401
Telephone	:	(0721) 482 478
Facsimile	:	(0721) 482 478
Website	:	http://www.bbes-mesujisekampung.com
E-mail	:	
Legal Basis	:	Regulation of Minister of Public Works Number 23/ PRT/M/2008 jo Number 28/PRT/M/2008
Work Area	:	Mesuji-TulangBawangRiver Basin
River Basin Code	:	01.46.A2, Cross-provincial

Seputih-Sekampung River Basin, River Basin Code: 01.48.A3, National Strategic River Basin

1.2. Brief History

BBWS Mesuji-Sekampung is the Department of Public Works' technical implementation unit in the Province of Lampung which task is to ensure the implementation of water resources management from the upstream to the downstream of river basins in a comprehensive, integrated, sustainable and environmentally sound manner.

Before the establishment of BBWS Mesuji-Sekampung (as mandated in Law Number 7 of 2004 regarding Water Resources), the Department of Public Works, in particular the Directorate General of Water Resources, had work units which function was to carry out construction work as well as non-construction work in each province.

Specifically in Lampung Province, the work units which manage water resources consist of several Non-Vertical Work Units for Particular Purpose (SNVT), including:

- SNVT for the Mainstay Irrigations and Swamps of Lampung;
- SNVT for Raw Water Management; and
- SNVT for the Main Implementer of Way Seputih-Way Sekampung River Basin

Development, which supervises the following:

  - SNVT for Water Resources Development and Conservation;
  - SNVT for Flood Control and Coastal Protection; and
  - SNVT for Way Seputih-Way Sekampung Floods

Each of these Non-Vertical Work Units for Particular Purpose (SNVT) coordinates with the relevant directorate within the Directorate General of Water Resources, Department of Public Works, according to the area managed.

1.3. Organizational Structure

The Large River Basin Organization of Mesuji-Sekampungis categorized as a type-B large river basin organization with an organizational structure that consists of:

1) Administration Department
2) Program and General Planning Division
3) Implementation Division
4) Water Resources Operation and Maintenance Division

The implementation of the activity budget is carried out by 3 work units, namely:

1) Work Unit of BBWS Mesuji-Sekampung, 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 I
   d) Contract Executive Officer for Water Resources Operation and Maintenance II

2) Non-Vertical Work Units for Particular Purpose (SNVT) for the Implementation of Water Source Network of BBWS Mesuji-Sekampung, consisting of 3 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 Water Resources Conservation Utilization

3) Non-Vertical Work Units for Particular Purpose (SNVT) for the Implementation of Water Utilization Network of BBWS Mesuji-Sekampung, consisting of 4 Contract Executive Officers:

   a) Contract Executive Officer for Swamp Irrigation I
   b) Contract Executive Officer for Swamp Irrigation II
   c) Contract Executive Officer for Swamp Irrigation II
   d) Contract Executive Officer for Raw Water

1.4. Human Resources

The total number of employees in BBWS Mesuji-Sekampung is 487 people, consisting of 164 technical employees and 323 non-technical employees, with details as shown in the following Table 1:

Table 1: Human Resources in BBWS Mesuji Sekampung

No	Education	Civil Servant						Total
		Central		DPB Daerah		DPB Dinas&Kab.		
		Technical	Non-Technical	Technical	Non-Technical	Technical	Non-Technical	
1	S 2 (Master's Degree)	31	7	0	0	0	0	38
2	S 1 / D IV (Bachelor's Degree / 4-year Associate Degree)	35	48	8	9	0	0	100
3	D 3 (3-year Associate Degree)	5	6	6	1	1	0	19
4	Senior High School	46	116	25	74	7	28	296
5	Junior High School	0	12	0	7	0	6	25
6	Elementary School	0	2	0	3	0	4	9
Total		**117**	**191**	**39**	**94**	**8**	**38**	**487**

1.5. General Condition of Work Area

The western region of Lampung Provinceis a mountainous area as a series of Bukit Barisan. There are three mountains with heights over 2000 meters above the sea level, namely Mount Pesagiin West Lampung Regency with a height of 2,239m, Mount Tanggamus in Tanggamus Regency with a height of 2,102m and Mount Tebak in North Lampung Regency with a height of 2,315m.

The population growth of Lampung Province in the period of 1990-2000 reached 1,01% (Central Bureau of Statistics/Statistics Indonesia, 2004). This population growth was supported with improved public health rate, birth rate and decreased mortality rate. The composition of the population and the area of the Lampung Province are shown in Table 2 below.

Table 2: Number of Population in BBWS Mesuji Sekampung

No	Regency/Municipality	Area	Male	Female	Total
1	West Lampung	495,040	204,641	183,472	388,113
2	Tanggamus	335,661	415,766	385,843	801,609
3	South Lampung	318,078	616,066	576,230	1,192,296
4	East Lampung	433,789	459,954	430,344	890,298
5	Central Lampung	478,982	556,395	526,099	1,082,494
6	North Lampung	272,563	282,810	272,289	555,099
7	Way Kanan	392,163	184,592	175,252	359,844
8	TulangBawang	777,084	385,331	348,189	733,520
9	Bandar Lampung	19,296	395,514	393,423	788,937
10	Metro	6,179	62,244	61,496	123,740
Total		**3,528,835**	**3,563,313**	**3,352,637**	**6,915,950**

Source: Lampung DalamAngka (Lampung in Numbers) 2004/2005 (Pesawaran Regency is included in South Lampung Regency)

1.5.1. Mesuji-TulangBawang River Basin

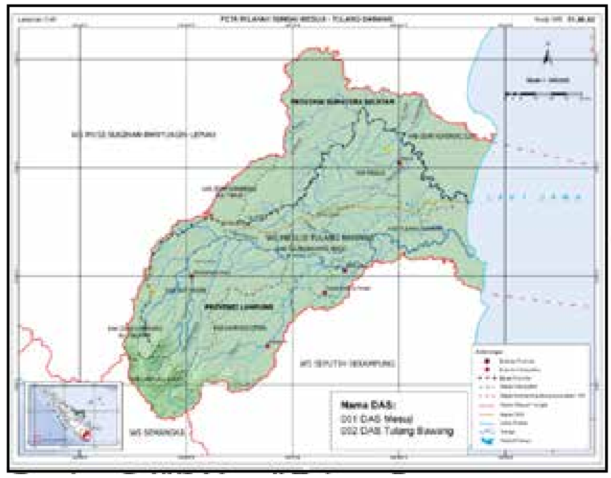


Figure 2: Mesuji-TulangBawang River Basin

The Mesuji-Tulang Bawang River Basin is located between 4° 22’ South Latitude to 5° 22’ South Latitude and 104° 32’ East Longitude to 105° 54’ East Longitude with an area of 16,625 km² (41.5% of the total area of Lampung Province), and consists of 3 watersheds, namely Mesuji Watershed which covers an area of ± 6,760 km² and Tulang Bawang Watershed which covers an area of ± 9,865 km².

Water resource potentials in Mesuji-Tulang Bawang River Basin include:

- Surface water availability potential amounts to 20.2 billion m³/year;
- Groundwater potential amounts to 251.4 million m³/year.

The Mesuji-TulangBawang River Basin covers several regencies/municipalities, namely:

a) West Lampung Regency
b) Way Kanan Regency
c) North Lampung Regency
d) Central Lampung Regency
e) TulangBawang Regency
f) Some of the regencies in South Sumatera Province

1.5.2. Seputih-Sekampung River Basin

Figure 3 Seputih-Sekampung River Basin

The Seputih-Sekampung River Basin is located between 4° 37’ South Latitude to 5° 55’ South Latitude and 104° 30’ East Longitude to 105° 52’ East Longitude with an area of 13,225 km² (33% of the total area of Lampung Province), and consists of 42 watersheds.

Among the watersheds, the two large ones are the Seputih Watershed which covers an area of ± 7,550 km² and Sekampung Watershed which covers an area of ± 5,675 km².

Water resource potentials in Seputih-Sekampung River Basin include:

- Water fulfillment potential is 80%, amounting to 14.2 billion m³/year;
    - Run-off potential: 7.4 billion m³
    - Interflow: 6.8 billion m³
- Groundwater potential amounts to 0.293 billion m³/year.

The Seputih-Sekampung River Basin covers several regencies/municipalities, namely:

a) West Lampung Regency
b) Tanggamus Regency
c) Central Lampung Regency
d) Pesawaran Regency
e) East Lampung Regency
f) South Lampung Regency
g) Tulang Bawang Regency
h) Bandar Lampung Municipality
i) Metro Municipality

1.6. Hydrology

The climate in the work area of BBWS Mesuji-Sekampung is influenced by 2 seasons, namely the dry season and the rainy season. The average daytime temperature ranges from 31.20°C to 34.10°C, while temperatures at night range from 21.70°C to 28.40°C.

The average rainfall is 160.90 mm/month. The highest rainfall of this province occurs in December, reaching up to 388.3 mm/month and the lowest is in August at 9.8 mm/month.

- The Mesuji-TulangBawang River Basin's annual rainfall ranges from 2,500 mm/year to 3,100 mm/year with a mean of 2,800 mm/year;

- The Seputih-Sekampung River Basin's annual rainfall ranges from 1,234 mm/year to 2,565 mm/year with a mean of 1,878 mm/year.

In BBWS Mesuji-Sekampung's work area there are 7 Climatological Stations, 118 Rainfall Stations, and 52 Water Observation Stations, as shown in the following Figure 4.

Figure 4: Distribution of Hydrological Stations in BBWS Mesuji-Sekampung

1.7. Budgets of 2011 and 2012

The following Table 3 shows the budget for the Program and General Planning Division, and the data presented in the table shows that there is a Foreign Loan component in addition to the State Budget component. The 2012 budget experienced a decrease compared to the 2011 budget.

Table 3: Budgets of BBWS Mesuji-Sekampung

Fiscal Year	National Budget (APBN)	Foreign Loan	Total
2011	10,620,724	408,000	11,028,724
2012	8,874,350	1,760,000	10,634,350

1.8. Issues

a) Flood and Drought

The declining condition and carrying capacity of watersheds are caused by illegal forest clearing and improper utilization management, which then gives rise to erosion and sedimentation, increased flood intensity during the rainy season, and occurrences of drought in the dry season.

Table 4: Flood Inundation Areas

No	Watershed	Area of Inundation (Ha)	Source of Flood
1	Mesuji	203,700	Mesuji River, Buaya River, Padang River, Menang River
2	TulangBawang	173,070	TulangBawang River, Rarem River, Umpu/ Kanan River

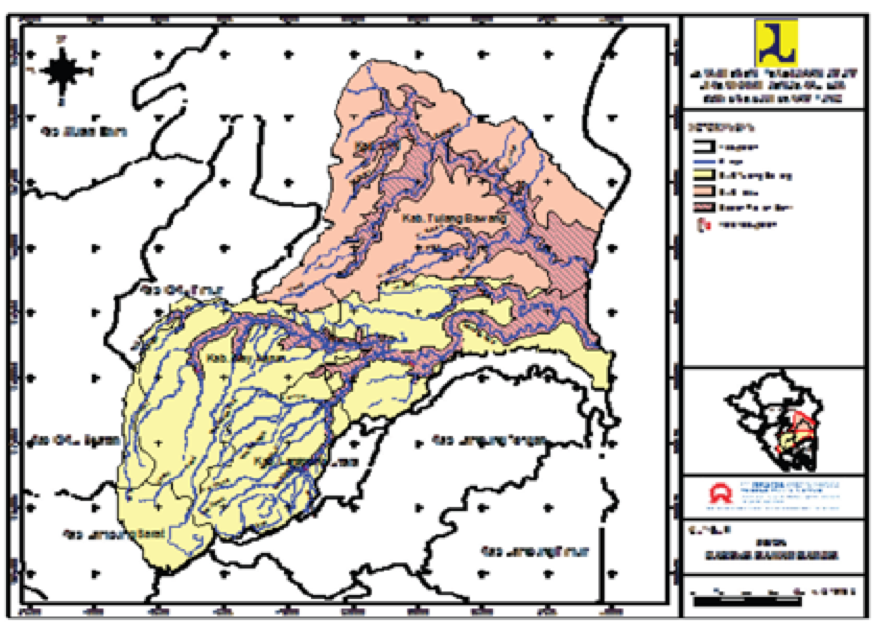


Figure 5: Flood-prone Areas in BBWS Mesuji-Sekampung

Figure 5 above shows that flood-prone areas are mainly found on the right and left sides of the rivers, which is caused by the overflowing of river water. To control this flooding, it is necessary to build embankments with length of approximately 214 km and at least 17 check dams.

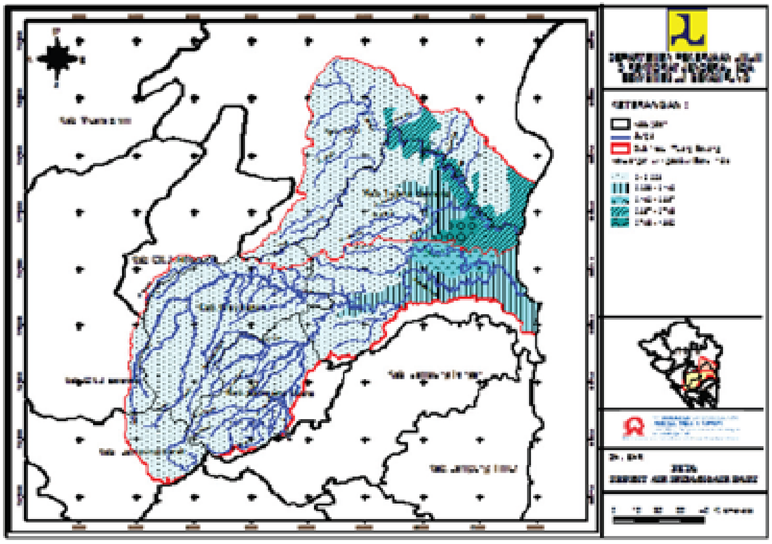


Figure 6: Distribution of Drought-prone Areas

Table 5: Drought-prone Areas

No	Sub-regency	Area (Ha)
1	Menggala	254
2	GedongAji	964
3	TulangBawang Tengah	143
4	Mesuji	630
5	SimpangPematang	602
6	Penawara Tama	242
7	Tanjung Raya	72
Total		**2,907**

In the dry season, there are at least 7 sub-regencies with a total area of 2.907 hectares which are susceptible to drought, as seen in Table 5. In addition, there are 17 irrigation areas with water shortage, which locations are spread all over the Lampung Province.

b) Erosion and Sedimentation

The upper part of BBWS Mesuji-Sekampung's work area, especially the area between Batutegi Dam and Argoguruh Dam, has turned into areas of settlement, plantation and dry-land. This condition causes increased river discharge accompanied by sediment content when it rains. Such condition is worsened by sand mining activities in several river channels, in which these sand mining activities do not comply with the existing rules, such as the requirement to own a permit, selection of location, etc.

Table 6 below shows that most areas experience moderate and high rates oferosion, while Figure 7 shows how areas with potential of erosion are almost equally spread across the river basin.

This condition greatly affects the water resource infrastructures located at the downstream, including Batutegi Dam, Dam Rarem Way, and Way Jepara Dam, as well as the irirrigation networks.

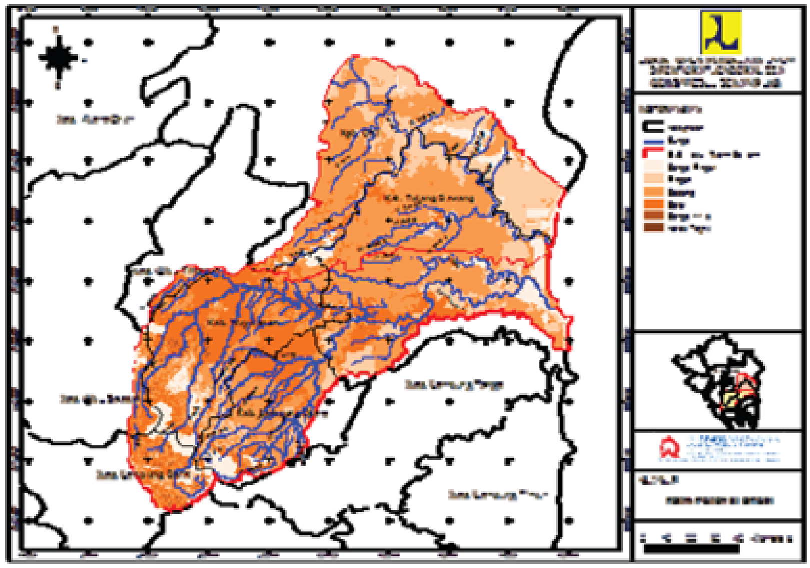


Figure 7: Distribution of Areas with Potential of Erosion

Table 6: Erosion Index

No	Erosion Index	Erosion Rate	Area (Ha)
1	Very Mild	0 - 6,25	128,145.83
2	Mild	6.25 - 62.50	330,445.99
3	Moderate	62.50 - 187.50	801,535.44
4	Heavy	187.50 - 625	376,347.43
5	Very Heavy	625 - 2,500	11,675.03
6	Catastrophic	> 2,500	0.75

c) Coastal Abrasion

Coastal abrasion occurs frequently in several areas such as in Jalan Banding in South Lampung Province, Bandar Lampung Municipality, Way Lunik, Way Sukamaju, Way Penet, Way Sukamaju, Karya Tani village beach, and Karya Makmur in Labuhan Manggarai sub-regency.

d) Limited Facilities and Infrastructures of Water Resources Management

The number and capacities of the existing water storage facilities and infrastructures (reservoirs and traditional reservoirs/embung) are still limited. Therefore, the utilization of water resource potentials and regional potentials is not yet optimal, whereasthefacilities and infrastructuresat the same timecanalsoserve toreduce theintensity offloodsin therainyseasonanddroughtin the dry season.

e) Management of Water Resources Management Infrastructures

Until today, the management of water resources management infrastructures, including the irrigation and Swamp networks, has not been running optimally, and so the utilization also has not been optimal and the area of planting realization is not yet formed as planned.

In the case of Batutegi Dam management, for instance, the multipurpose dam which is used not only to irrigate the Sekampung Irrigation Area but also for a Hydroelectric Power Plant with a capacity of14 MW.

The operational model of Batutegi Damin supplying water to the Sekampung Irrigation Area is guided by the Decree of the Governor of Lampungon Global Plant Layout Plan that is published each year. Given that the main purpose of the Batutegi Damis for irrigation, the operation of the Hydro electric Power Plant then adjusts the water release schedule for the irrigation. This condition often raises a conflict of interest given that Lampung Province is often constrained in terms of power supply requirements and availability.

Such condition occurs in the management of BatutegiDam, which led to an imbalance of in flow and out flow of BatutegiDam. Since 2005, the water surface elevation has continued to decline. The lowest point of water surface elevation decline occurred in September 2008,which was +226m(48 m below thenormal water level+274m). Out of the total carrying capacity of ±690million m^3, there was only ±95million m^3 at the time. The storage condition changed to almost like the original stream. Large trees that were also submerged seemed to rise to the water surface.

Based on the results of evaluation on the data, it was found that the decline in the availability of water in Batutegi Reservoir was caused not only by the damaged vegetation along the river between the Batutegi Dam and Argoguruh Dam, but also by a lack of coordination between the BatutegiDam operational officers and the Argoguruh Dam guards. When the data were matched, it was seen how frequently overlapping occurred, in which there was water supply when there was already sufficient amount of water in the rice fields. Since that moment, the management of Batutegi Dam restricted the water release for irrigation by increasing coordination in real-time manner, and the water surface elevation in Batutegi Reservoir then started to slowly increase and a spill-out occurred in September 2010.

Figure 8: Batutegi Reservoir at High Water Level and Low Water Level

When water surface elevation declined, the inundation area turned into land and was used for dry-land farming by the people. This was because the water surface decline occurring since 2005 to 2008 made the people living around the inundation believe that the reservoir's water level would never rise again.

When the water surface elevation started to rise, the dry-land area became submerged again. This caused weeds to get carried into the inundation area.

The growth of the weeds that got carried into the inundation area was very fast, which then made 70% of the Batutegi Reservoir's inundation filled with weeds at the end of 2009.

To clear up the inundation area, the Batutegi Dam management attempted to lift the weeds ashore by involving the community around the dam.

Figure 9: Weeds in Batutegi Reservoir

When a spill-out occurred in 2010, the weeds were flushed away through a spillway. But since the spill-out only lasted for 2 months, the weed flushing was not completed and at the end of 2010, approximately 10% of the weeds still remained there.

Given that the weed growth is very fast, the inundation area today is still full of weeds. The lifting of the weeds by involving the community around the dam is still being carried out until this year (2012).

Figure 10: Over flow in Batutegi Reservoir Spillway

2. WATER RESOURCES MANAGEMENT

2.1. Water Resources Conservation

Water resources conservation is aimed to lower the erosion and sedimentation rates in critical areas which are found abundantly in BBWS Mesuji-Sekampung's work area.

- Not Potentially Critical : 594,010 hectares
- Potentially Critical : 834,492 hectares
- Rather Critical : 1,051,507 hectares
- Critical : 310,212 hectares
- Very Critical : 174,647 hectares

The critical levels of the areas are indicated by the size of the river regime coefficients which are far greater than the normal value, which is 1:20.

The river regime coefficients of several rivers are recorded as follows:

- Way Seputih 1 : 80
- Way Sekampung 1 : 125
- Way TulangBawang 1 : 86
- Way Mesuji 1 : 50

The implementation of this activity is carried out together with other agencies such as the Office of Agriculture, Office of Plantation, Office of Forestry, Office of Human Settlement, etc., and also through the GNKPA forum.

These GNKPA activities are started with an agreement to carry out Forest and Land Rehabilitation as well as Water Resources Conservation in TulangBawang Watershed, Way Rarem Sub-watershed and Way Abung Sub-watershed, and also the Community Empowerment of Tulang Bawang Watershed.

Figure 11: GNKPA Activities of Tanggamus Regency

2.2. Water Resources Utilization

In addition to being utilized for clean water, water resources in BBWS Mesuji-Sekampung are also primarily utilized for irrigation. The water is obtained from the utilizationof reservoirs, *embungs*, swamps and groundwater. This has brought success to the agricultural sector and made Lampung Province as one of the national rice barns, with rice production as shown in the following Table 7.

Table 7: Water Resources Utilization in BBWS Mesuji-Sekampung

No	Regency/Municipality	Wetland Rice (Ton)	Dry-land Rice (Ton)	Total (Ton)
1	West Lampung	100,175	3,115	103,290
2	Tanggamus	229,004	6,045	235,049
3	South Lampung	361,593	20,956	382,549
4	East Lampung	329,927	16,911	346,838
5	Central Lampung	385,939	63,330	449,269
6	Lampung Utara	85,276	31,727	117,003
7	Way Kanan	109,396	28,428	137,824
8	TulangBawang	282,009	12,879	294,888
9	Bandar Lampung	7,722	375	8,097
10	Metro	17,149	40	17,189
Total		**1,908,190**	**183,806**	**2,091,996**

Source: Lampung dalamAngka (Lamoung in Numbers) 2004/2005

The table above shows that the amount of rice produced from dry-land faming is relatively large and these areas have a potential to be developed into technical irrigation areas.

The Lampung Province is one of the top national provinces in rice production. There are more than 295,000 hectares of irrigation from 732 Irrigation Areas. Irrigation Areas larger than 3,000 ha extend to 214,150 ha, while Irrigation Areas between 1,000–3,000 ha extend to 24,150 ha and Irrigation Areas smaller than 1,000 ha extend to 56,700 ha. The main Irrigation Areas include Way Sekampung System with potential area of 66,591 ha and Seputih Irrigation Area with potential area of 20,201 ha, covering the Central Lampung Regency, South Lampung Regency, East Lampung Regency and Kota Metro Municipality.

The irrigation development that is currently being conducted in the Mesuji-Tulang Bawang River Basin is the development of Komering Irrigation, which covers an area of 120,000 ha. The Komering Irrigation is a cross-provincial irrigation that includes South Sumatera and Lampung provinces. The area in the South Sumatera province extends to 75,000 ha, while in Lampung, the area extends to 45,000 ha, located in Way Kanan and Tulang Bawang.

a) Dams

Until today, as many as three dams have been built, namely:

Table 8: Dams in BBWS Mesuji-Sekampung

No	Name of Dam	River Basin	Year of Construction	Height (M)	Effective Volume (Million M³)
1	Way Jepara	Seputih - Sekampung	1975 - 1978	16.60	22.25
2	Way Rarem	Mesuji - Tulang Bawang	1980 - 1984	32.00	56.90
3	Batutegi	Seputih - Sekampung	1994 - 2002	122.00	665.00

Figure 12: Batutegi Dam and Way Jepara Dam

b) Traditional Reservoirs (embung)

As many as 66 *embungs* with a total capacity of 20.75 million m³ have been built in the work area of BBWS Mesuji-Sekampung.

Figure 13: Traditional Reservoir (embung)

c) Swamps

The swamp area potentials extending to 128,953 ha consist of non-tidal swamp area extending to 62,300 ha (25,578 ha have been developed), and tidal swamp area extending to 66,653 ha (50,198 ha have been developed). The total areas that have been developed therefore extend to 75,776 ha.

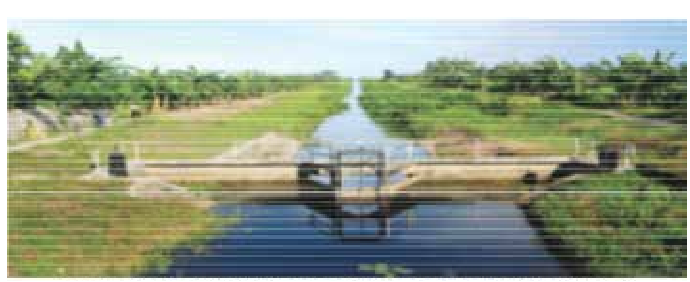


Figure 14: Development of Sragi Swamps

Development of groundwater is intended to irrigate dry areas that are not covered by surface water irrigation network. The potential for groundwater irrigation development extends to 61,600 ha and by 2007, 130 Groundwater Irrigation Networks have been constructed with total areas of 1.380 ha as well as rural raw water infrastructures for 800 families.

Figure 15: Groundwater Development

e) Raw Water

Raw water capacity development potentials amounting to 5,180 l/sec are distributed in 5 regencies, namely South Lampung, North Lampung, East Lampung, West Lampung and TulangBawang. Until 2007, as many as 19 infrastructures and facilities for urban and rural raw water have been built with total discharge of 1,580 l/sec. These infrastructures and facilities provide services for more than 15,760 families.

Figure 16: Raw Water Development

2.3. Control of Water Destructive Power

a) Emergency Management of Flood Infrastructures

Control of water destructive power is carried out to ensure that roads, agricultural areas, industrial zones, settlement and urban areas as well as water resource facilities and infrastructures are able to keep functioning. The Lampung Province requires approximately a 53 km long flood protection, approximately 214 km of embankments and approximately 17 check dams, including design work, namely:

- Way Kandis Flood Management Design Review
- Re-designing of Way Batanghari Flood Management in East Lampung Regency
- Way Seputih/Way Tatayan Flood Management Design Review
- Detail Design and Preparation Studies on the Preparation of Environmental Management

Efforts/Environmental Monitoring Efforts for Minor Rehabilitation of Jepara Dam

- Special Studies for Large-scale Rehabilitation, Dam Security Improvement and Performance Improvement of Batutegi Reservoir
- Re-designing of Way TulangBawang Flood Management

Figure 17: Flood Control Structure and River Improvement

b) Coastal Abrasion Control

Coastal protection work has been started since 2006 as part of the efforts to safeguard and protect public infrastructures against coastal abrasion. In 2007, a 1.000 m long revetment was built at Jalan Banding Beach in South Lampung Regency, and also jetties at Way Kahuripan (239 m), Way Lunik (166 m) in Bandar Lampung Municipality, and at Way Sukamaju (86 m). In 2008, plans were made for the extension of the revetment at Jalan Banding Beach by 200 m, construction of Way Penet Beach revetment (290 m), and construction of jetty at Way Sukamaju (162 m).

Figure 18: Revetment at Way Penet Beach and Jetty at Way Sukamaju

In order to support the implementation, the following design activities were carried out:

- Detail Design for KaryaTani Village Beach Protection in LabuhanMaringgai Sub-regency
- Detail Design for KaryaMakmur Village Beach Protection in LabuhanMaringgaiSub-regency
- Design for Margasari Village Beach Protection in East Lampung Regency
- Design for Ketapang Beach Protection in South Lampung Regency

2.4. Water Resources Information System

The water resources information system is managed by the Water Resources Information System (SISDA) Unit of BBWS Mesuji-Sekampung. As part of the effort to support the implementation of bureaucracy reform acceleration program (quick win) within the Directorate General of Water Resources, especially in conducting data acceleration and water resources data and information provision optimization, BBWS Mesuji-Sekampung organizes Water Resources Data Processing Version 4.0 trainings.

2.5. Community Empowerment and Participation

Community empowerment, monitoring and involvement, especially in terms of a comprehensive water resources management, are carried out through the Water Resources Management Coordination Team (TKPSDA) forum of Mesuji-TulangBawang and the TKPSDA forum of Speutih-Sekampung. Furthermore, in order to support the Government Program Implementation, particularly in Lampung Province as part of the effort to support food self-sufficiency, the BBWS Mesuji-Sekampung, through the Work Unit of BBWS Mesuji-Sekampung for Water Resources Operation and Maintenance II of fiscal year 2011, has organized a Training-of-Trainers (TOT) and Comparative Study program at Ciamis.

Training for Water-Saving Rive Farmers (Application of Water-saving Rice Cultivation in System of Rice Intensification/SRI). The training was held in LPMP Building in Lampung Province from November 8 to November 12, 2011. The training was attended by ± 30 participants from relevant agencies, instructors/resource persons from Aliksa Organic Center, and farmer group from Untoro Village, Trimurjo Sub-regency, Central Lampung Regency.

Figure 19: Workshop, Training and Comparative Study

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. General

As has been described in the previous chapter, water resources management in the work area of BBWS Mesuji-Sekampung is primarily carried out for irrigation other than for clean water and power generator. The infrastructures are already available, and they are able to be developed (extensification) and optimized in their capacities (intensification) in order to provide more benefits for the stakeholders.

a) Water Resource Development Potentials in Seputih-Sekampung River Basin include:

1) Development/Improvement of Irrigation Networks in an area of 153,334 ha
2) Development/Improvement of Swamp Networks in an area of 12,924 ha
3) Development of Water Resources for Hydroelectric Power Plants with a capacity of 39 MW
4) Development and Management of Raw Water Networks with a capacity of 5,000 l/sec

5) Development of Water Resources for Tourism, namely Batutegi Reservoir and Way Jepara Reservoir
6) Development of Water Resources for Fisheries, namely Batutegi Reservoir and Way Jepara Reservoir

b) Water Resource Development Potentials in Mesuji-TulangBawangRiver Basin include:

1) Development/Improvement of Irrigation Networks in an area of 94,665 ha
2) Development/Improvement of Swamp Networks in an area of 50,000 ha
3) Development of Water Resources for Hydroelectric Power Plants with a capacity of 216 MW
4) Development and Management of Raw Water Networks with a capacity of 4,000 l/sec
5) Development of Water Resource for Tourism, namely Way Rarem Reservoir
6) Development of Water Resource for Fishery, namely Way Rarem Reservoir

In addition to developing the benefits of the existing infrastructures, the work area of BBWS Mesuji-Sekampung has water resource potentials that can still be further developed, such as:

1) Construction of dams in 7 locations spread in Mesuji-TulangBawang River Basin and Seputih-Sekampung River Basin;

2) Development of *embungs*. There are approximately 166 locations and at present, only 66 *embungs* have been constructed.

3) Development of swamp potentials, both non-tidal swamps and tidal swamps, covering a total area of 53,177 hectares as seen in the table below.

Table 9: Swamp Development Potentials

No	Type of Swamp	Total Potential (Ha)	Developed (Ha)	Remaining Potential (Ha)
1	Non-tidal Swamp	62,300	25,578	36,722
2	Tidal Swamp	66,653	50,198	16,455
Total		**128,953**	**75,776**	**53,177**

4) Development of raw water

Raw water development potentials amounting to 3,600 l/sec are spread in 5 regencies, namely South Lampung, North Lampung, East Lampung, West Lampung and TulangBawang. This raw water development needs to be carried out immediately in order to meet the household and industrial development requirements in Lampung.

3.2. Comprehensive Management

By nature, the Lampung Province, including the work area of BBWS Mesuji-Sekampung, has great natural resources. Water resources management is still very possible to be developed for the benefits of all stakeholders.

However, the water resources management should not only prioritize the utilization aspect, but it should also be balanced with the aspects of water preservation and control of water destructive power.

Planning activities should also emphasize not only on the series of implementation, but they should also take into consideration the operation and maintenance afterwards.

The experience gained in the operation of Batutegi Reservoir, for instance, has given a very valuable lesson in conducting water management, which shows that water management should not only focus on the utilization aspect, but also on the water preservation aspect and control of water destructive power aspect. In addition, water resources management is not monopolized by the water resources sector only, but it is also the responsibility and obligation of other related sectors. In short, it is necessary to create a comprehensive and integrated water resources management.

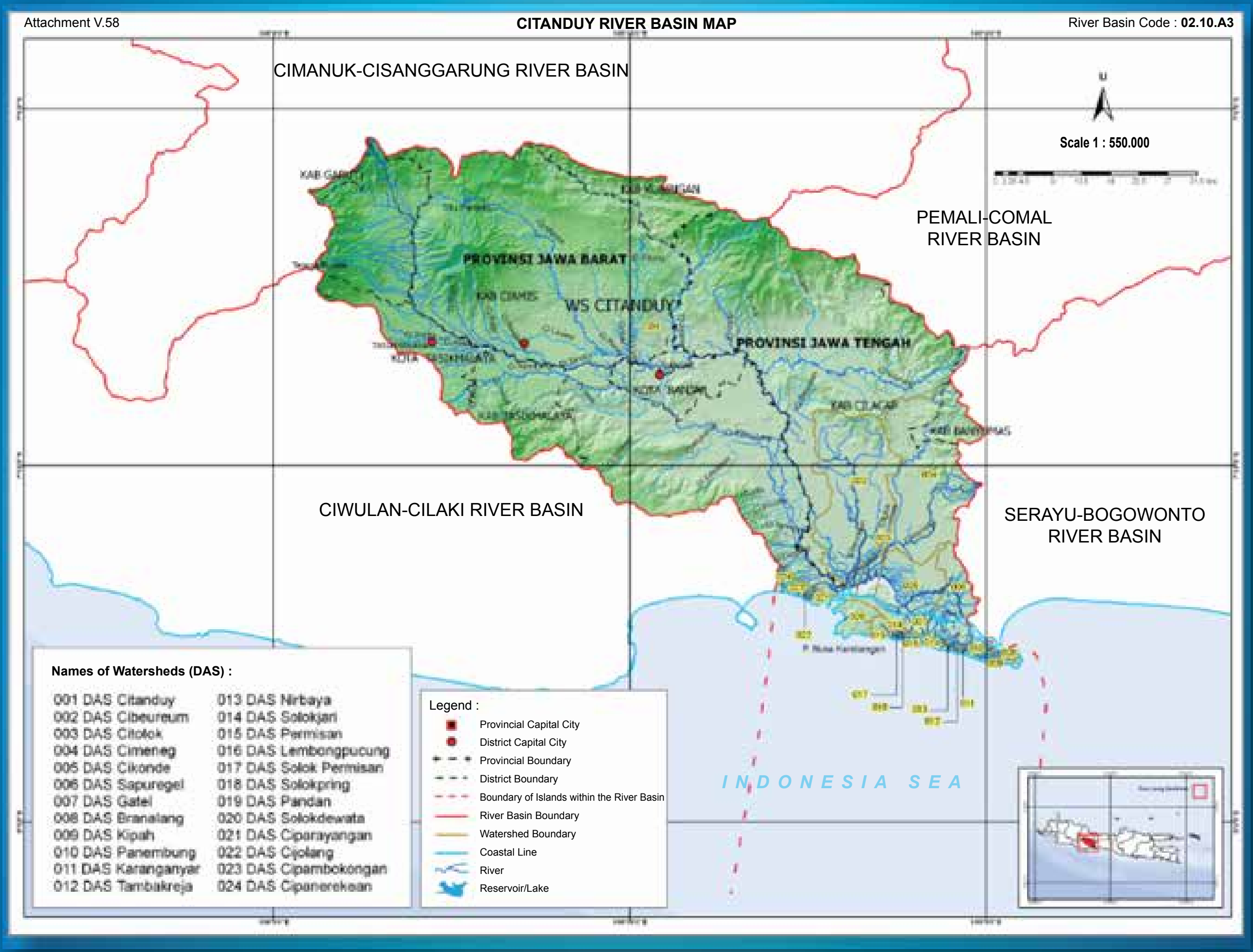
3.3. Implementation Strategy

Water is an absolute necessity for all living things, especially humans. Therefore, water and water resources management always involve the interests of all people and sectors they represent.Water resource infrastructures development should no longer consider only the economic benefits, but it should also consider the social and environmental factors.

Due to this, the development of water resource infrastructures becomes more expensive. Meanwhile, the availability of development funds is very limited. Therefore, it requires an appropriate implementation strategy, which is by conducting a prioritization based on the criteria that are acceptable to all stakeholders.

In addition, the implementation of water resource management infrastructures development is not only the responsibility ofthe water resources sector. Therefore,other sectors can also provide their contributions to the funding and implementation, including the private sector and the public, through the procedures as stipulated in existing regulations. The mechanism for the implementation has also been set up in accordance with the regulations, which is, among others, through the TKPSDA forum.

B1. LARGE RIVER BASIN ORGANIZATION OF CITANDUY



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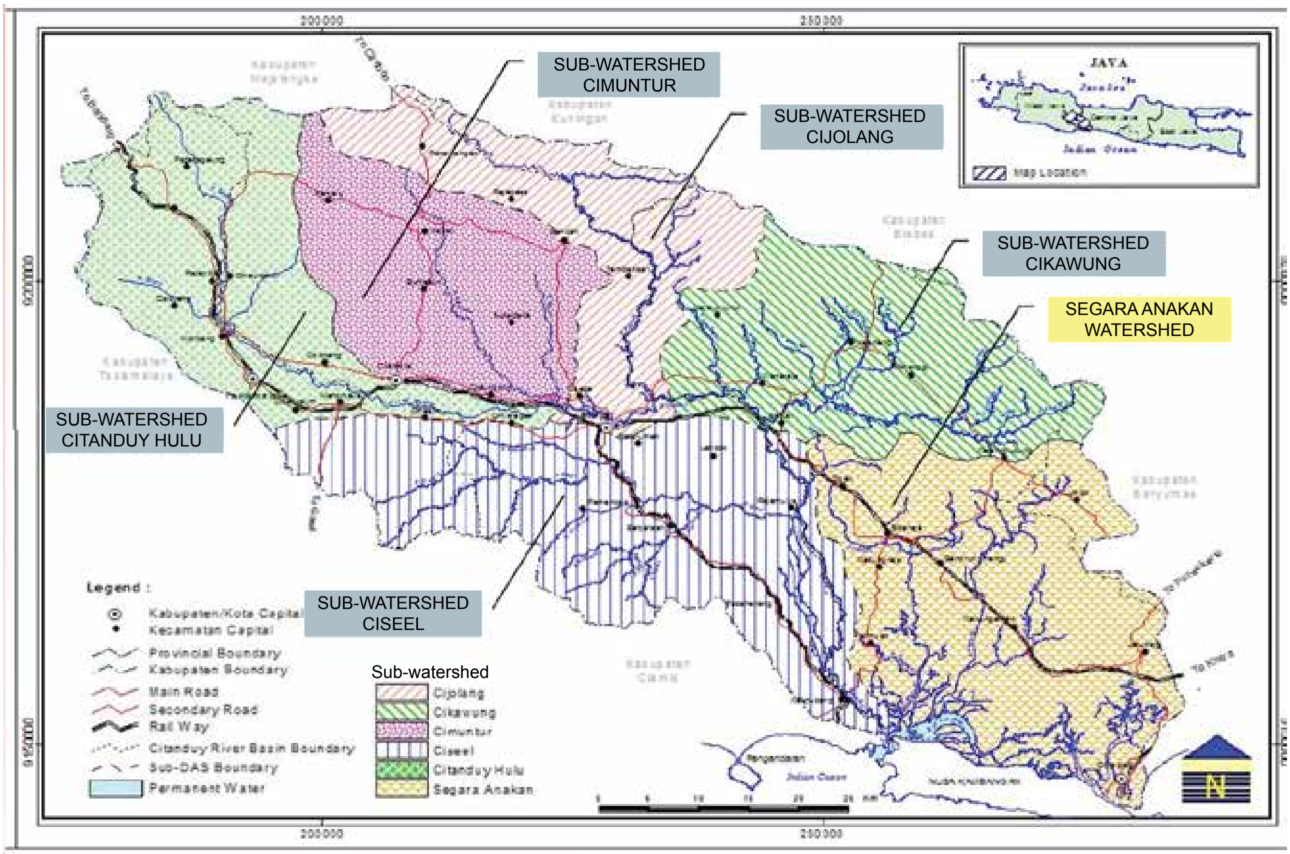


Figure 1: Citanduy River Basin

1.1. General Information

Name	:	Balai Besar Wilayah Sungai Citanduy
Address	:	Jl. Prof. DR. Ir. H. Sutami No. 1
Municipality	:	Banjar, West Java - 46300
Telephone	:	(0265) 741051, 741219
Facsimile	:	(0265) 741302
Website	:	http://www.bbwscitanduy.com
E-mail	:	
Legal Basis	:	Regulation of Minister of Public Works Number 23/ PRT/M/2008
Work Area	:	CitanduyRiver Basin, River Code: A2-13
River Basin Classification	:	Cross-Provincial River Basin (West Java Province–Central Java Province)

1.2. Brief History

1970	:	Citanduy-Ciwulan River Basin Development Project
1980	:	Citanduy-Ciwulan River Basin Development Master Project
1990	:	Balai Besar Wilayah Sungai Citanduy
2008	:	Citanduy Project

1.3. Organization Structure

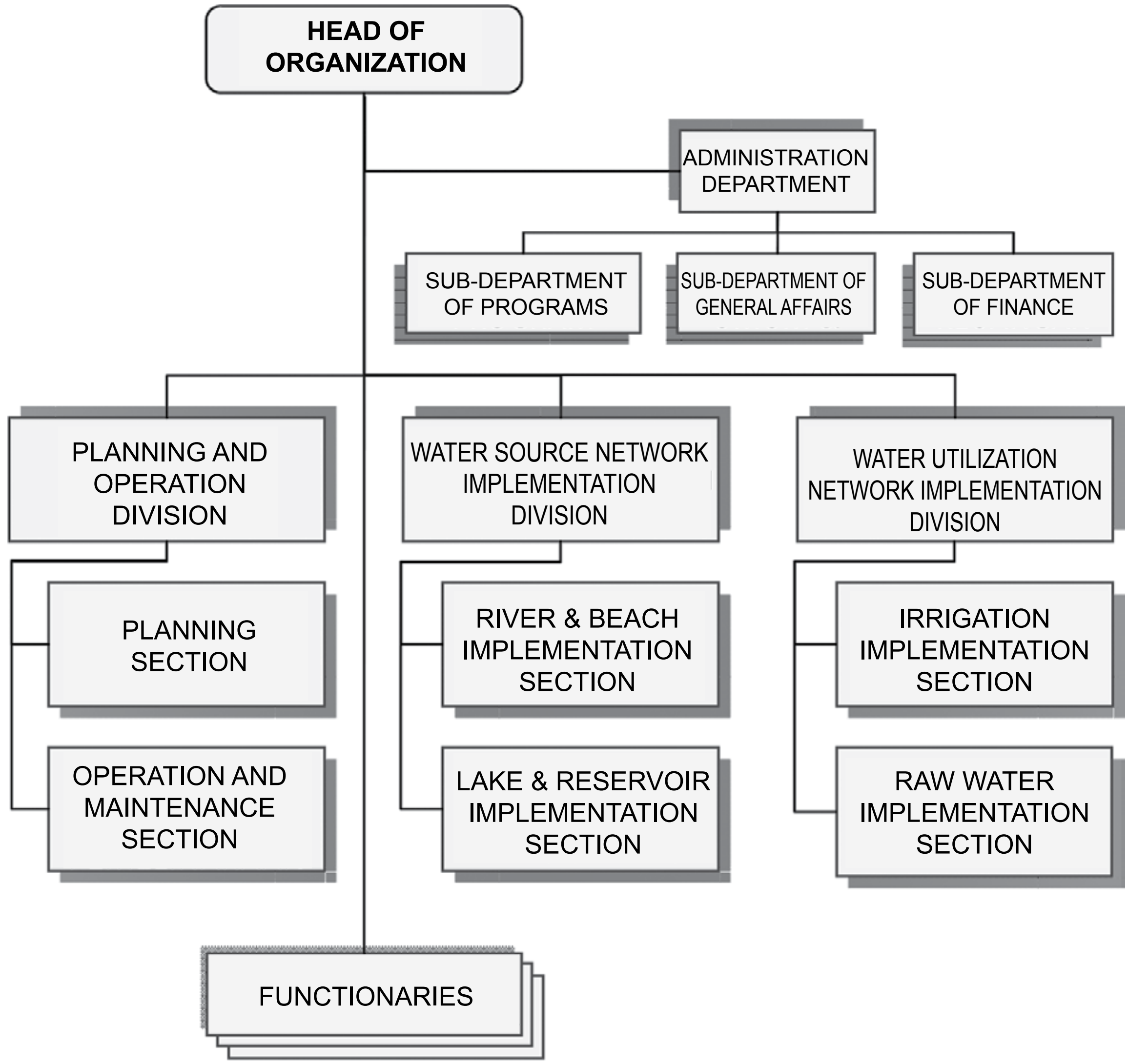


Figure 2: Organizational Chart of BBWS Citanduy

The organizational structure of Balai Besar Wilayah Sungai (BBWS) Citanduy or the Large River Basin Organization of Citanduy was established by the Regulation of Minister of Public Works Number 23/PRT/M/2008, and in accordance with its category as a type-B Large River Basin Organization, the BBWS Citanduy as seen in the figure above is a structural organization led by a second-echelon Head of Organization who is assisted by three third-echelon Heads of Divisions, as shown in the organizational structure above.

In addition to the structural organization, the BBWS Citanduy is also equipped with three functionary organizations, namely:

1) BBWS Work Unit
2) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Utilization Network Implementation
3) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Source Network Implementation

1.4. General Condition of Work Area

Figure 3: Work Area of BBWS Citanduy

Geographically, the work area of BBWS Citanduyis located at 108°04’East Longitude to 109°30’ East Longitude and 7°03’ South Latitude to 7°52’South Latitude.Administratively, the area is located in six regencies and two municipalities in West Java Province and Central java Province. This work area extends to 455,000 hectares, as shown in the following Table 1.

Table 1: Extent of BBWS Citanduy’s Work Area

No	Regency/Municipality	Area of Regency/ Municipality (Ha)	Citanduy River Basin	
			Area of Water-shed (Ha)	%
West Java Province				
1	Ciamis Regency + Banjar Municipality	255,371	150,000	32.97
2	Tasikmalaya Regency & Municipality	268,048	68,000	14.95
3	Kuningan Regency	111,700	27,200	5.98
4	Majalengka Regency	120,424	18,400	4.04
Central Java Province				
5	Cilacap Regency + Banyumas Regency	214,257	191,400	42.07
Total			**455,000**	**100.00**

Table 2: Population Growth Projection

No	Regency / Municipality	Population Projection				
		2006	2011	2016	2021	2026
1	Tasikmalaya Regency	435,419	457,630	480,974	505,509	531,295
2	Majalengka Regency *)	17,736	18,696	19,708	20,775	21,900
3	Kuningan Regency *)	32,015	34,831	37,894	41,226	44,852
4	Cilacap Regency *)	1,238,223	1,310,429	1,386,846	1,467,720	1,553,309
5	Tasikmalaya Municipality	350,124	368,530	387,905	408,297	429,762
6	Banyumas Regency *)	47,660	55,763	65,243	76,334	89,312
7	Ciamis Regency	1,172,956	1,178,833	1,184,739	1,190,674	1,196,640
8	Banjar Municipality	164,335	173,488	183,152	193,354	204,124
Total		**3,458,468**	**3,598,200**	**3,746,461**	**3,903,889**	**4,071,194**
Average		**432,309**	**449,775**	**468,308**	**487,986**	**508,899**

Based on Table 2 above, it can be seen that work area of BBWS Citanduy is inhabited by around 3,5 million people (based on the calculation in 2006) and the population is projected to be 4 million people in 2026. Within twenty years there will be a population growth of ± 18% or less than 1% per year. This indicates that urbanization does not or has not yet happened into the work area of BBWS Citanduy, but the concern is that there will be urbanization from the Citanduy river basin.

1.5. Hydrology

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

There are 18 (eighteen) rainfall monitoring stations in Citanduy River Basin distributed as shown in Figure 4 below.

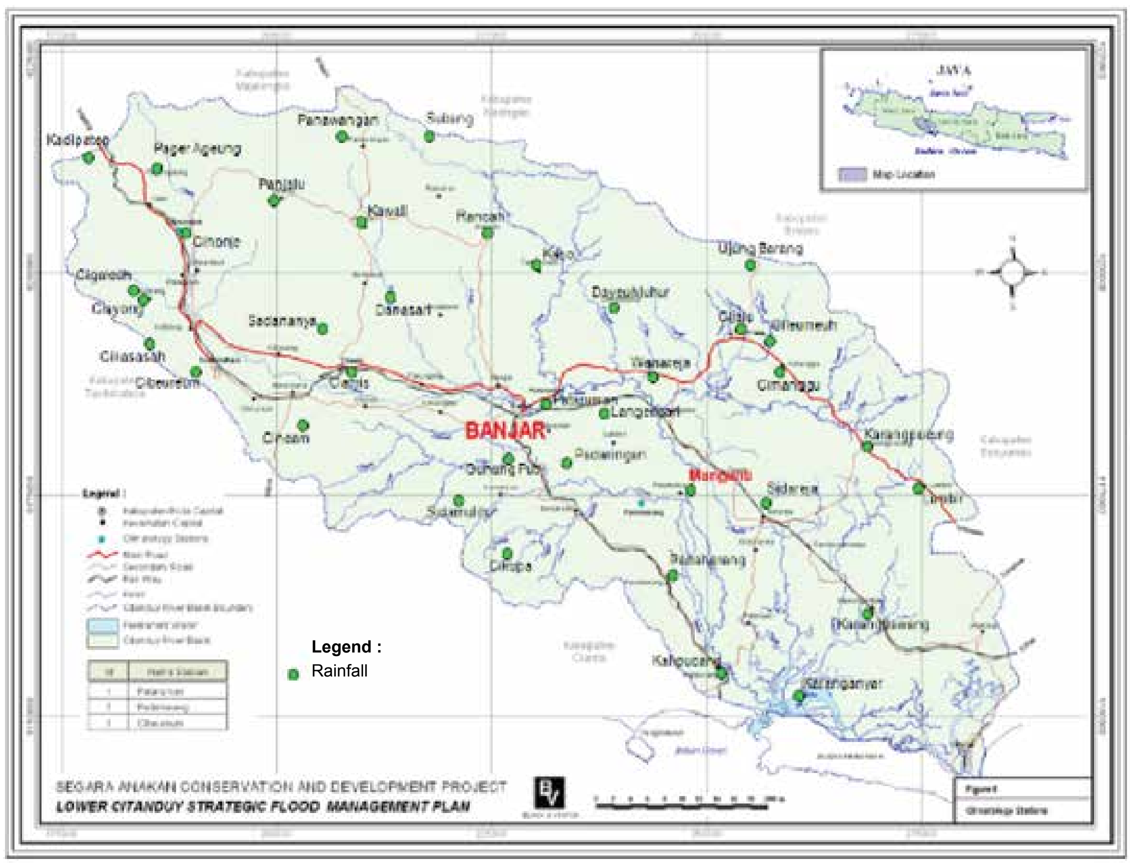


Figure 4 Location Map of Rain Monitoring Stations

Information from the rainfall monitoring stations have been recorded well until 2009. The information, including rainfall data for the periods of 2007, 2008 and 2009, can be found and obtained from the Water Resources Information System (SISDA) managed by the Organization, and they can be found and downloaded from the website of BBWS Citanduy.

In addition, there are also 21 (twenty one) water observation stations distributed in Banjar Municipality, Tasikmalaya Regency, Ciamis Regency and Cilacap Regency, as shown in Figure 5 below.

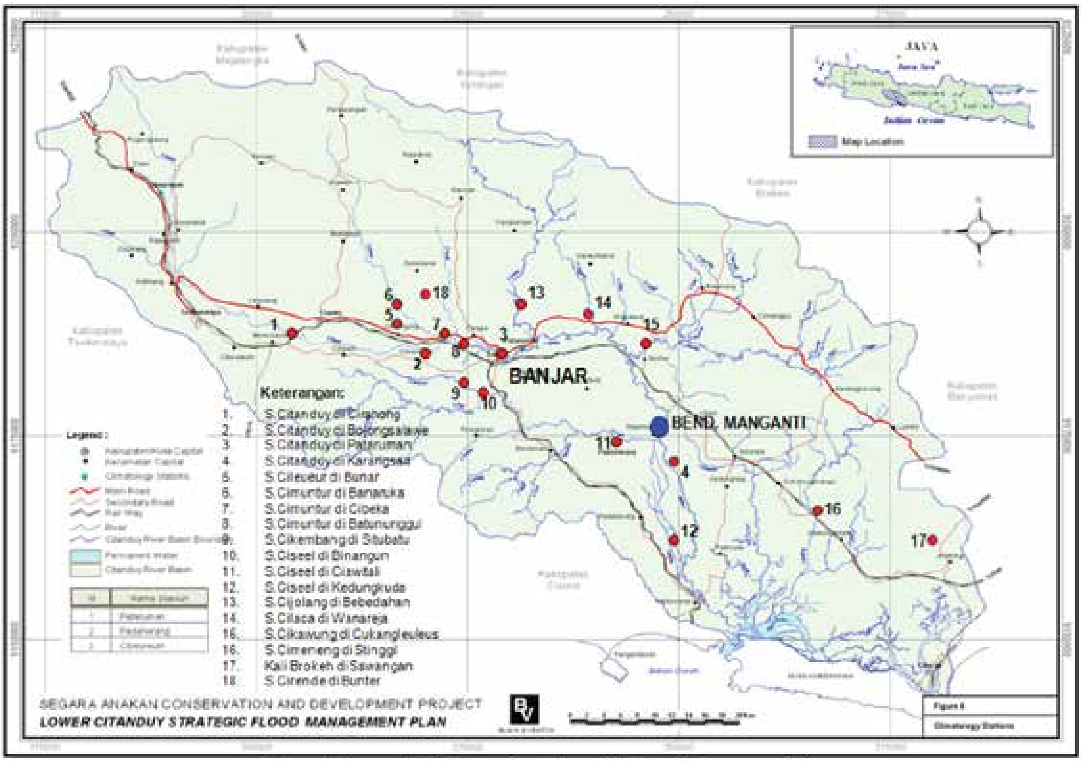


Figure 5: Location Map of Water Observation Stations

Information from the water observation stations have been recorded well for the periods of 2007, 2008 and 2009. The information, including water level data, can be found and obtained from the Water Resources Information System (SISDA) managed by the Organization, and they can be found and downloaded from the website of BBWS Citanduy.

1.6. Watersheds, Rivers and Tributaries

The BBWS Citanduy consists of two watersheds and five sub-watersheds, as shown in Table 3 below.

Table 3: Watersheds in Citanduy River Basin

No	Watershed	Sub-Watershed	Area (Ha)	Total Area (Ha)
1	Citanduy Watershed			350.000
		UpperCitanduySub-watershed	74,000	
		Cimuntur Sub-watershed	60,000	
		Cijolang Sub-watershed	48,000	
		Cikawung Sub-watershed	70,000	
		Ciseel Sub-watershed	98,000	
2	SegaraAnakan Watershed			105,000
Total				**455,000**

The two watersheds consist of 175 tributaries, ranging from the first order to the fifth order, with total lengths of more than 777 kilometers and total watershed areas extending to 4,400 hectares, as shown in Table 4 below.

Table 4: River Orders, River Lengths and Watershed Areas

No	River Order	Total	Length (KM)	Watershed Area (Ha)
1	1	1	175.00	3,500
2	2	52	345.12	980
3	3	75	183.25	n.a
4	4	38	68.25	n.a
5	5	8	n.a	n.a
Total		**174**	**771.62**	**4,480**

According to the Regulation of Minister of Public Works Number 11A/2006, the Citanduy River Basin consists of 8 watersheds, namely Cimeneng, Kadalmeteng, CiputraPinggan, Sapuregel, Kawungeten, Cikonde, Cikembulan and Cihaur.

Meanwhile, the Presidential Decree Number 12 of 2012 states that the Citanduy River Basin consists of 24 watersheds as shown on the map on the cover page.

Table 5: Artificial Lakes (situ)

No	Name of Artificial Lake (Situ)	Area (Ha)	Regency
1	Lengkong	50.00	Ciamis
2	Ciater	3.00	Ciamis
3	Cibubuhan	3.00	Ciamis
4	Cilembu	2.40	Tasikmalaya
5	Sadewata	1.50	Ciamis
6	Wangi	5.00	Ciamis
7	Rancamaya	2.00	Ciamis
8	Mustika	1.00	Kota Banjar
9	Cisaladah	7.00	Tasikmalaya
10	Cibeureum	7.00	Kota Tasikmalaya
11	Cipajaran	3.50	Tasikmalaya
12	Malingping	3.00	Tasikmalaya
13	Rusdi	0.15	Kota Tasikmalaya
14	Bojong	1.80	Tasikmalaya
15	RawaBendungan	300.00	Cilacap
16	Hiyang	10.00	Ciamis
17	Golempang	1.50	Ciamis
18	RancaBojongmengger	2.00	Ciamis
19	Kadupandak	2.00	Ciamis
20	Padahurip	3.50	Ciamis
21	Cimari	3.00	Ciamis
22	Kaso	1.50	Ciamis
Total		**408.20**	

In Citanduy River Basin, there are 22 (twenty two) artificial lakes with a total area of 408.20 ha, as shown in Table 5 above. The artificial lakes are located in many regencies and are managed by the local communities, villages, offices and some of them are managed by the Department of Forestry.

Other than that, there are also 43 traditional reservoirs (embung) spread in Cilacap Regency (12), Ciamis Regency (22), Kuningan Regency (1) and Tasikmalaya Regency (8).

1.7. Issues

A variety of issues are faced by the water resources management in Citanduy River Basin, such as:

a) Critical Lands

The following table on critical lands shows that there are three Citanduy sub-watersheds which critical levels are more than 10 percent, namely Cikawung, Ciseel and Segara Anakan.

Table 6: Critical Lands in Citanduy Watershed

No	Sub-Watershed	UNCRITICAL		MILDLY CRITICAL		CRITICAL	
		Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
1	Upper Citanduy	57,994.83	79.57	8,851.50	12.14	3,914.10	5.37
2	Cijolang	45,197.46	82.50	4,025.07	7.35	3,876.12	7.08
3	Cimuntur	51,804.00	84.16	6,183.09	10.05	1,988.10	3.23
4	Cikawung	53,337.51	76.21	6,033.42	8.62	8,018.82	11.46
5	Ciseel	78,009.03	78.39	7,584.84	7.62	10,989.00	11.04
6	SegaraAnakan	76,536.18	66.60	10,079.91	8.77	17,851.68	15.53

Figure 6: Critical Lands in Citanduy Watershed

b) River Regime Coefficients

The hydrological condition of critical watersheds, especially in the second-order river of Cimeneng, is indicated by the high river regime coefficients, as shown in Table 7 below.

Table 7: River Regime Coefficients

No	Name of River, Location of AWLR	River Order	Annual Qmax	Annual Qmin	Qmax/ Qmin
1	Citanduy in Pataruman	1	846	5.63	150
2	Citanduy in Manganti	1	927	5.86	158
3	Cimuntur in Batununggal	2	323	4.43	67.63
4	Cijolang in Bedebahan	2	323	4.37	73.9
5	Cikawung in Cukangleuleus	2	300.04	11.34	26.44
6	Ciseel in Ciawitali	2	285	2.43	117.2
7	Cimeneng in Stinggil	2	143.88	0.05	2,877.60

b) Erosions and Sedimentations

From the erosion phenomena shown in the following table, it can be seen that the Cijolang Sub-watershed, Cikawung Sub-watershed and Segara Anakan Sub-watershed are categorized as sub-watersheds with heavy level of erosion.

Table 8: Erosion and Sedimentation

No	Sub-Watershed	Area (Ha)	Actual Erosion (t/ha/year)	Potential Erosion (t/ha/ year)	Sediment (mm/ year)	Level of Erosion
1	Upper Citanduy	74,800	131.24	596.56	1.40	Moderate
2	Cimuntur	60,500	88.55	245.96	0.91	Mild
3	Cijolang	48,030	408.24	1,570.16	4.88	Heavy
4	Ciseel	96,500	73.95	528.20	0.74	Mild
5	Cikawung	72,250	268.36	1,490.87	3.08	Heavy
6	Segara Anakan	110,000	181.88	1,653.46	2.00	Heavy

The critical land condition and erosion phenomena led to sedimentation in the downstream area, which then gave rise to siltation and the narrowing of Segara Anakan Lagoon's area, as shown in the following Figure 7 (Study by ECI, 1994).

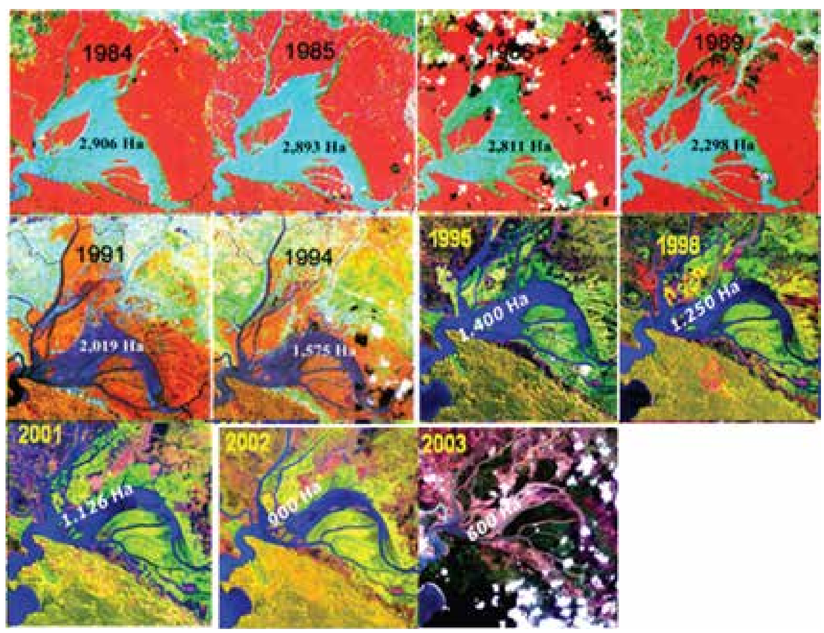


Figure 7: Sedimentation in Lagoon

Table 9: Lagoon Area'sRate of Decline

Year	Area (Ha)	Year	Area (Ha)
1984	2,906	1992	1,800
1985	2,893	1994	1,575
1986	2,811	2000	1,200
1989	2,298	2001	800
1991	2,019	2003	600
1992	1,800	2005	834

The total sedimentation that entered into SegaraAnakan is 5,000,000 m³/year and the amount deposited in the SegaraAnakan Lagoon is 1,000,000 m³/year.

The sedimentation not only causes siltation, but also reduces the lagoon's surface area. The emergence of a new land due to the sedimentation also led to conflicts of interest related to its utilization.

Figure 8: Sedimentation in Cikonde River Mouth

d) Floods and Droughts

The critical hydrological condition of Citanduy Watershed results in high coefficient of river regime or high maximum discharge-minimum discharge ratio. The direct impacts are “excess” of water in the rainy season and “lack” of water in the dry season, or in other words, floods and droughts.

Areas with potential of flooding are spread in Kuningan Regency, Majalengka Regency, Tasikmalaya Regency & Municipality, Ciamis Regency and Banjar Municipality (in West Java Province), Cilacap Regency and Banyumas Regency (in Central Java Province), covering a total area of 73,350 hectares, as shown in the following Figure 9.

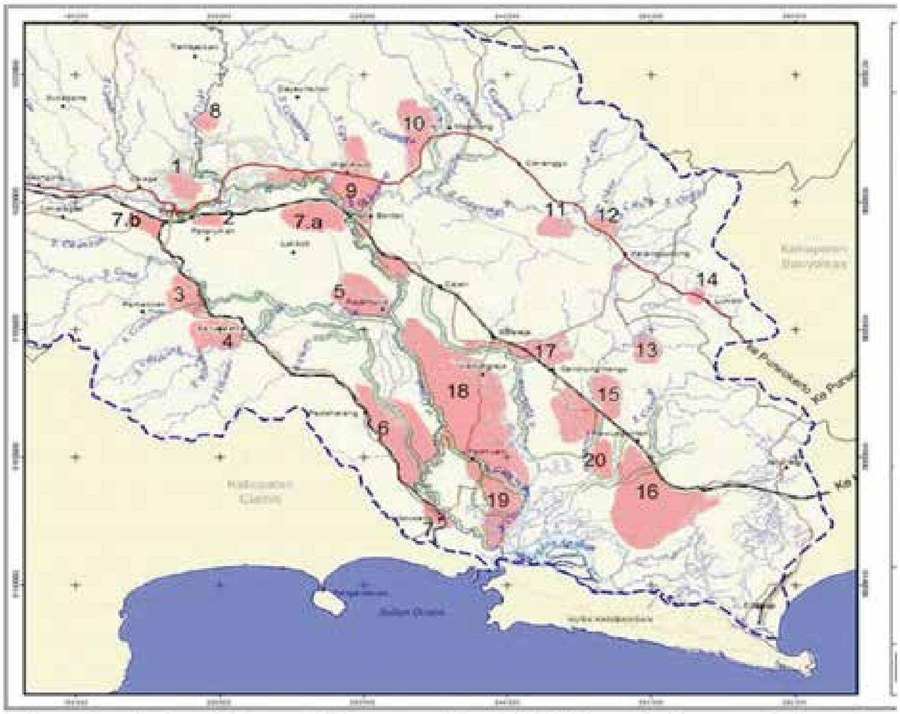


Figure 9: Locations of Flood Potential Areas in Citanduy River Basin

Table 10: Dry Irrigation Areas

No	Name of Irrigation Area	Sub-regency	Regency/Municipality	Area (Ha)
1	Cikunten II	Manonjaya	Kab. Tasikmalaya	45
2	Cikunten II	Cibeureum	Kota Tasikmalaya	323
3	South Lakbok	Padaherang	Kab. Ciamis	821
4	North Lakbok	Lakbok	Kab. Ciamis	26
5	North Lakbok	Purwadadi	Kab. Ciamis	109
6	RawaOnom	Cisaga	Kab. Ciamis	19
7	RawaOnom	Purwaharja	Kota Banjar	52
8	North Lakbok	Langensari	Kota Banjar	53
Total				**1,448**

Source: Inventorying Study of Areas Susceptible to Flood, Landslide and Drought in Citanduy River Basin by PT. SAE CITRA INDAH Consultant, FY 2008

Areas that experience drought are irrigation areas located in various sub-regencies in Ciamis Regency, Tasikmalaya Regency & Municipality and Banjar Regency & Municipality. In total, Irrigation Areas that experience drought extend to 1,448 hectares, as presented in the details of Table 10 above.

Figure 10: Citanduy River at the Upper Part of Pataruman Weir

Areas that experience shortage of raw water include 21 sub-regencies spread in 4 regencies, as shown in the following table.

Table 11: Droughted Irrigation Areas

No	Regency	Sub-regency
1	Ciamis Regency	Kawali, Panawangan, Kalipucang, Banjarsari
2	Cilacap Regency	KampungLaut, Kawunganten, Bantarsari, Patimuan, Kedungreja
3	Tasikmalaya Regency	Singaparna, Mangunjaya
4	Tasikmalaya Municipality	Tawang, Cibeureum, Kawalu Tamansari, Purbaratu

e) Landslides

In Citanduy River Basin, there are at least 13 villages in 4 regencies which are prone to landslides. The names and locations of those villages can be seen in the following Table 12.

Table 12: Landslide-prone Areas in Citanduy River Basin

No	Province	Regency	Sub-regency	Village
1	West Java	Tasikmalaya	Pagarageung	Guranteng
		Ciamis	Rancah	Rancah
			Tambaksari	Kadupandak
				Kaso
			Panawangan	Sadapaingan
				Cinyasang
				Indragiri
2	Central Java	Cilacap	Wanareja	Cukangleuleus
				Malabar
			Majenang	Bener
				Boja
		Banyumas	Lumbir	Lumbir
				Parungkamal

Figure 11: Riverbank Landslide

Landslides also occurred in several riverbanks and this increased the amount of sediment that led to siltationin the downstream.

2. WATER RESOURCES MANAGEMENT

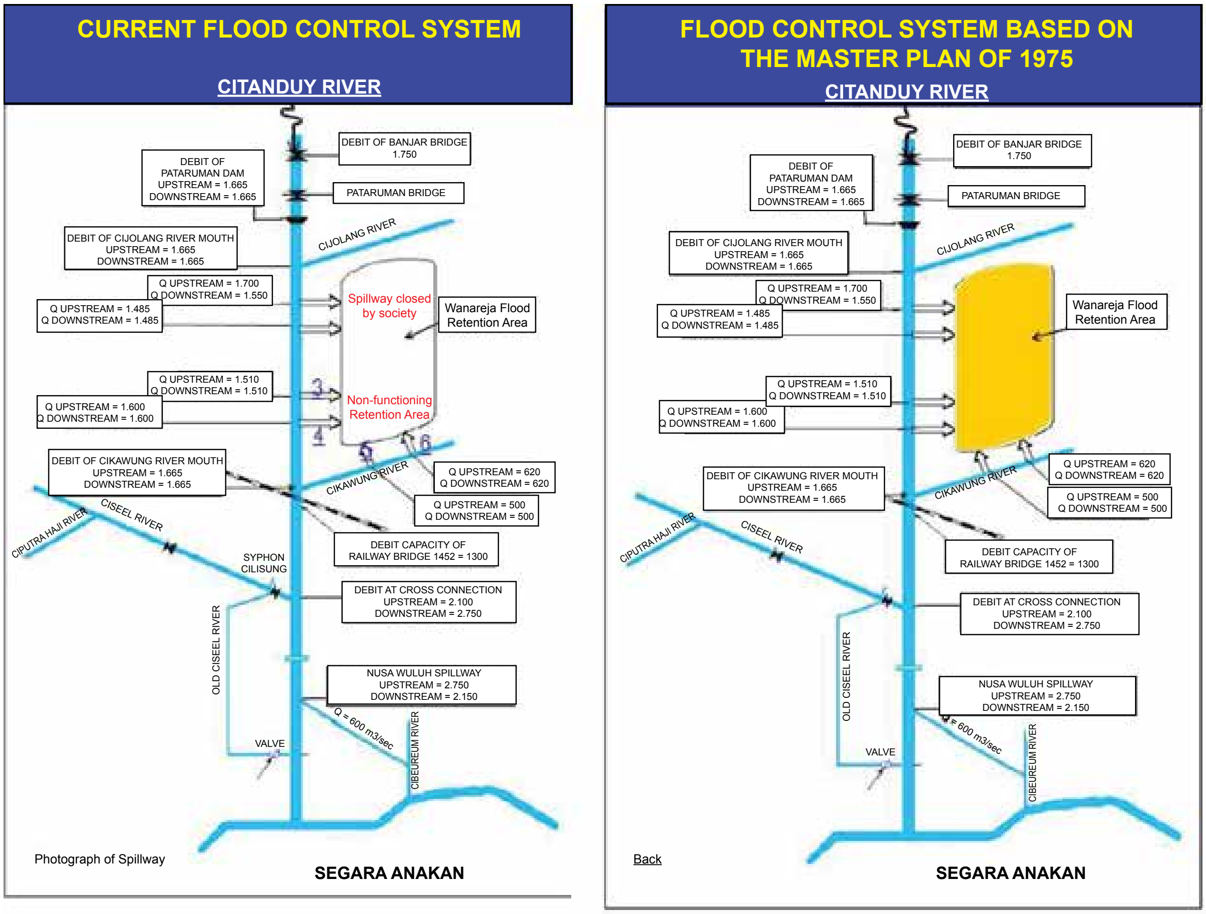


Figure 12: Flood Control System Based on the Master Plan of 1975 and the Current

Based on the 1975 Master Plan, the water resources management in Citanduy River Basin was initially carried out as an attempt to control flooding (The Citanduy River Basin Development Project Master Plan, Directorate General of Irrigation, Department of Public Works, 1975).

The 1975 Master Plan was further developed to examine flood prevention efforts through a study on early warning system (The Citanduy River Basin Development Project Flood Warning Study, Directorate General of Irrigation, Department of Public Works, October 1984).

In 2003, attempts to develop raw water potentials were started in order to meet various requirements for water in accordance with results of studies (Raw Water Potential Identification Study in Citanduy-Ciwulan Area, CitanduyCiwulan River Basin Development Master Project, Citanduy-Ciwulan Water Source Development and Management Project, Guidance and Planning Project Division, July 2003).

According to Law Number 7 of 2004 regarding Water Resources, water resources management has to be based on a management model which preparation must involve all stakeholders, including empowering, monitoring and involving the community through the Water Resources Management Coordination Team (TKPSDA).

Therefore, in 2010, the model was prepared by taking into consideration a variety of management aspects and not just flood prevention and irrigation aspects.

Since 2008, the Mount Galunggung Eruption Management Project has been merged as a part of BBWS Citanduy.

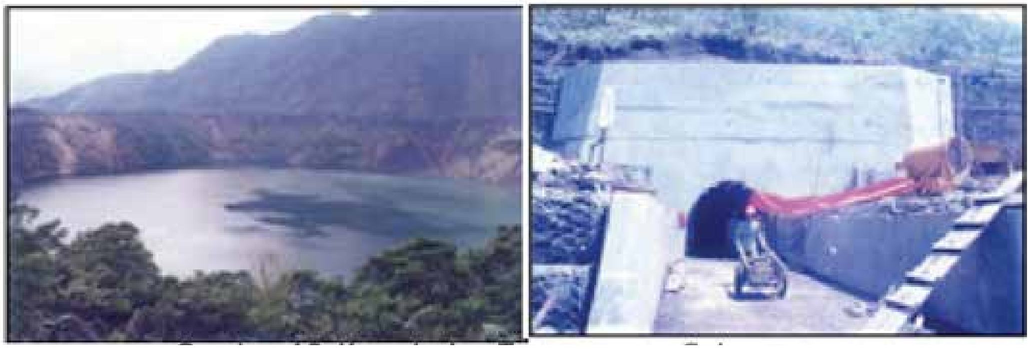


Figure 13: Galunggung Crater and Tunnel

In addition, BBWS Citanduy also manages coastal protection activities, especially against abrasion. Some of the coastal locations that have been managed are the Pangandaran Beach, Bojongsalawe Beach, Bagolo Beach and so on.

Figure 14: Bojongsalawe Beach and Pangandaran Beach

2.1. Water Resource Conservation

Figure 15 SegaraAnakan

a) Segara Anakan

One of the conservation objects in Citanduy River Basin is SegaraAnakan because it has an important value and the potential to be developed aside from the issues that occur in the area.

Important Value of Segara Anakan:

- Estuarine ecosystem, germplasm, place/habitat for various species of organisms, natural resources of flora and fauna
- Food chain or a place for fish to feed
- Large and small river mouth, which is the Citanduy River

Potentials of SegaraAnakan:

- Mangrove tourism around the waters in the channel between Majingklak (Pangandaran) and Cilacap (Paket Pancimas or Pangandaran-Cilacap Banyumas Tour Package)
- Village Attraction Tourism
- Natural caves in Nusakambangan Island
- Rancababakan Beach, Permisan Beach on the Coast of Nusakambangan Island

Issues:

- Critical watersheds are increasingly expanding
- Erosion and sedimentation
- Lagoon area is decreasing and becomes increasingly shallow
- Conflict of interest in the utilization
- Environmental quality decline, pollution problem (garbage)
- Silting of river channels and estuaries
- Flood and drought

b) Check-dam

Check-dams are built with a primary purpose of preventing excessive sedimentation at the upper part and the mouth of rivers which causes a narrowing and siltation of river channels.

Several check-dams built in Mount Galunggung area function to prevent or reduce disasters caused by debris flow flood.

In several locations, the construction of a check-dam is accompanied with the construction of embankments on the right and left sides of the river channel in order to create a sand pocket.

Figure 16: Goler Check-Dam and Pisitan Check-dam

c) Traditional Reservoir (embung)

In Citanduy River Basin, there are 43 traditional reservoirs (embung) which are mostly utilized for irrigation, raw water and fisheries.

Effort of conservation is also carried out by constructing *embungs* to accommodate excess water during the rainy season, such as EmbungCilentah, EmbungCurugMujan, Embung Kaligombong, etc.

Figure 17: EmbungCurugMujan and EmbungCilentah

d) Artificial Lake (situ)

As many as 22 artificial lakes (situ) in Citanduy River Basin have been utilized for various requirements such as irrigation, fisheries, drinking water, tourism etc, and some are also utilized for water resources conservation, such as Situ Taraju.

Figure 18: Situ Taraju

2.2. Water Resources Utilization

Water resources utilization in Citanduy River Basin is still dominated by the fulfillment of irrigation requirement, which is the irrigation of rice fields in a total area of 42.882 hectares, located in West Java Province as well as in Central Java Province.

Figure 19: Manganti Weir and Cihaur-Sidareja Regulator

This is very reasonable because the value ofagricultural production reaches more than one trillion dollars each year, and agriculture is the main livelihood for more than one million inhabitants, as shown inthe following description.

Based on the management aspect, Irrigation Areas are categorized as follows:

1) Irrigation Areas which are under the authority of the Central Government, covering a total area of 28,464 hectares, located in West Java Province and Central Java Province, namely:

- West Java

i.	Rawa Onom Irrigation Area	:	947 ha
ii.	South Lakbok Irrigation Area	:	4,537 ha

- Central Java

i.	Sidareja Irrigation Area	:	9,188 ha
ii.	Cihaur Irrigation Area	:	13,229 ha
iii.	Panulisan Irrigation Area	:	563 ha

2) Irrigation Areas which operations and maintenance are co-administered by the provincial governments, covering a total area of 14,418 hectares, with details as follows:

i.	Sidareja Irrigation Area	:	9,188 ha
ii.	Cihaur Irrigation Area	:	13,229 ha
iii.	Panulisan Irrigation Area	:	563 ha

3) Irrigation Areas which are under the authority of the provincial, regency and municipality governments, covering a total area of 73,420 hectares.

4) Production Value Estimation

- Cropping patterns:

(a)	Cropping season I	:	Rice
(b)	Cropping season II	:	Rice
(c)	Cropping season III	:	Secondary crops

With cropping patterns as above, the cropping intensity is 175% per year.

- Rice production : 7 [tons/ha]
- Grain price : Rp 3,000,- [per kg]
- Irrigation areas managed directly by the Central Government (BBWS Citanduy): 28,464 ha
  Production value = 28,464 x 7,000 x 175% x Rp 3,000,- = Rp 1,046,052,000,000,-
- Irrigation areas co-administered with Provincial Government: 14,418 ha
  Production value = 14,418 x 7,000 x 175% x Rp 3,000,- = Rp 529,861,500,000,-
  Total Production Value = Rp 1,575,913,500

5) Number of People who receive direct income from irrigation management

- Estimated land ownership: 0.200 ha/farmer
- Estimated number of family members per farmer: husband, wife and three children, total 5 family members.
- Irrigation areas managed directly by the Central Government (BBWS Citanduy): 28,464 ha
  Number of Population = 28,464 ha / 0.20 ha x 5 persons = 711,600 persons
- Irrigation areas co-administered with Provincial Government: 14,418 ha
  Number of Population = 14,418ha / 0.20 ha x 5 persons = 360,450 persons
  Total Population = 1,072,050 persons

2.3. Control of Water Destructive Power

Figure 20: Riverbank Protection in Karangsari

To control water destructive power such as floods, debris flow floods, landslides with their many consequences including riverbank erosion, channel and lagoon siltation, many facilities have been built according to the management plan described in the beginning of chapter 2 above.

Some of the infrastructures that have been built are shown in the following Table 13.

Table 13: Main Infrastructures of Water Resources Management Constructed Until Fiscal Year 2009

No	DESCRIPTION	MASTER PLAN (1975)	REALIZATION
1	Flood Embankment	173 km	325 km
2	Dam	7 locations	0
3	Retarding Basin :		
	- Wanareja (Central Java)	1 location (1.000 Ha)	1 locations
	- Cipanggang (West Java)	1 location (± 600 Ha)	0
4	Flood Spillway	8 units	7 units
5	Valve :		
	- New	15 units	15 units
	- Rehabilitated	19 units	19 units
6	Ciseel - Citanduy Cross Connection	1.85 km	1.85 km
7	Cilisung Siphon	1 unit	1 unit
8	BantarheulangSiphon	1 unit	1 unit
9	Nusawuluh Flood Way	13.50 km	13.50 km
10	Water Resources Conservation		
	- Check Dam	0	50 locations
	- Terracing	1 location	1 location
	- Artificial Lake (situ)Rehabilitation	0	8 locations
	- Traditional Reservoir (embung)	0	11 locations
	- Rural Raw Water	0	20 locations
11	Manganti Barrage	1 unit	1 unit
12	Mount Galunggung Disaster Management /Sand Pocket	0	1 unit
	Check Dam, Tunnel, etc		
13	Irrigation Rehabilitation & Development		
	- Rehabilitation	22,793 Ha	22,793 Ha
	- New	28,493 Ha	30,000 Ha
14	Coastal Protection Structure	0	3 locations

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 Citanduy, which office is located on Jl. Prof. Dr. Ir. Sutami No. 1, Banjar, Telephoneb+62-265-741-302.

The information is stored on the official site of BBWS Citanduyand can be accessed through the following address: www.bbwscitanduy.com.

Some of the information that can be found and downloaded are:

- BBWS Citanduy profile
- Model Plan, 28 September 2010 edition
- Citanduy River Basin Water Resources Model Plan Matrix
- Information of Rainfall Data for 2007, 2008 and 2009
- Information of River Water Level Data for 2007, 2008 and 2009
- Information of Sedimentation for 2007, 2008 and 2009

2.5. Community Empowerment and Participation

Community empowerment, monitoring and involvement in water resources management are carried out through a variety of activities organized by two forums, namely the Water Resource Management Coordination Team (TKPSDA) and the National Movement for Water Safeguard Partnership (GN-KPA).

The Water Resource Management Coordination Team (TKPSDA) of Citanduy River Basin was established based on the Decree of Minister of Public Works Number 255/KPTS/M/2010 dated 2 March 2010 on the Establishment of Water Resource Management Coordination Team (TKPSDA) of Citanduy River Basin.

The Water Resource Management Coordination Team (TKPSDA) of Citanduy River Basin consists of 42 members in which 21 members represent governmental agencies and 21 members represent community organizations or non-governmental organizations.

The Community Participation Improvement Training As Part of the Implementation of the National Movement for Water Safeguard Partnership (GNKPA) has been held in Ciamis Regency, West Java on 12 – 14 October 2011.

GNKPA activities are carried out in 4 regencies and 2 municipalities with priorities set on Ciamis (CitalahabVilale; Karangjaya Sub-regency; Cibubur Village; Citaklakuk Village; Parung Sub-regency; Panteng Sub-regency), Tasikmalaya Regency; Garut and Cilacap, including acitivities in Manganti Weir and in Paruman Weir.

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. General

The most prominent aspect of water resources management in Citanduy River Basin is the aspect of utilization, specifically for irrigation.

Based on the IWAKO study in 1990, there are ± 94 springs in Ciamis regency with discharge of 1,1 liters/ second in each spring. On the slopes of Mount Sawal, there are large springs (discharge of 10-20 liters/ second) at the height of 400-800 MSL, with average spring discharge of 2 – 3 liter/ second, while for Tasikmalaya regency, there are 1015 springs.

Aside from that, there are also several locations with potential for reservoir construction, such as Matenggeng, Manonjaya, LeuwiKeris, Binangun 1 and Cikembang.

Some artificial lakes and traditional reservoirs also have the potential to be developed for irrigating rainfed rice fields.

3.2. Comprehensive Management

Water resources management in Citanduy River Basin can still be developed comprehensively by referring to various existing legal provisions and laws such as the article 51, 53, etc., of Law Number 7 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 Resource Management Coordination Team (TKPSDA) of Citanduy River Basin based on the Decree of Minister of Public Works Number 255/KPTS/M/2010 dated 2 March 2010 is understood as a mandate of Law Number 7 of 2004 regarding Water Resources, and the purpose it to accommodatethe aspirationsofall stakeholderson the management ofwater resources.

Therefore, the water resources management model recommended to the Minister of Public Works for approval should be able to present all aspects of managementin a comprehensive manner, as well as implement the mandates of all existing regulations.The Management Plan, as a detail of the Management Model, should 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.

3.4. Artificial Lake (situ) and Traditional Reservoir (embung)Development

Not all of the artificial lakes and traditional reservoirs in Citanduy River have been utilized, and they can still and need to be developed to irrigate rainfed rice fields, meet the raw water requirement, provide water for fisheries as well as tourism.

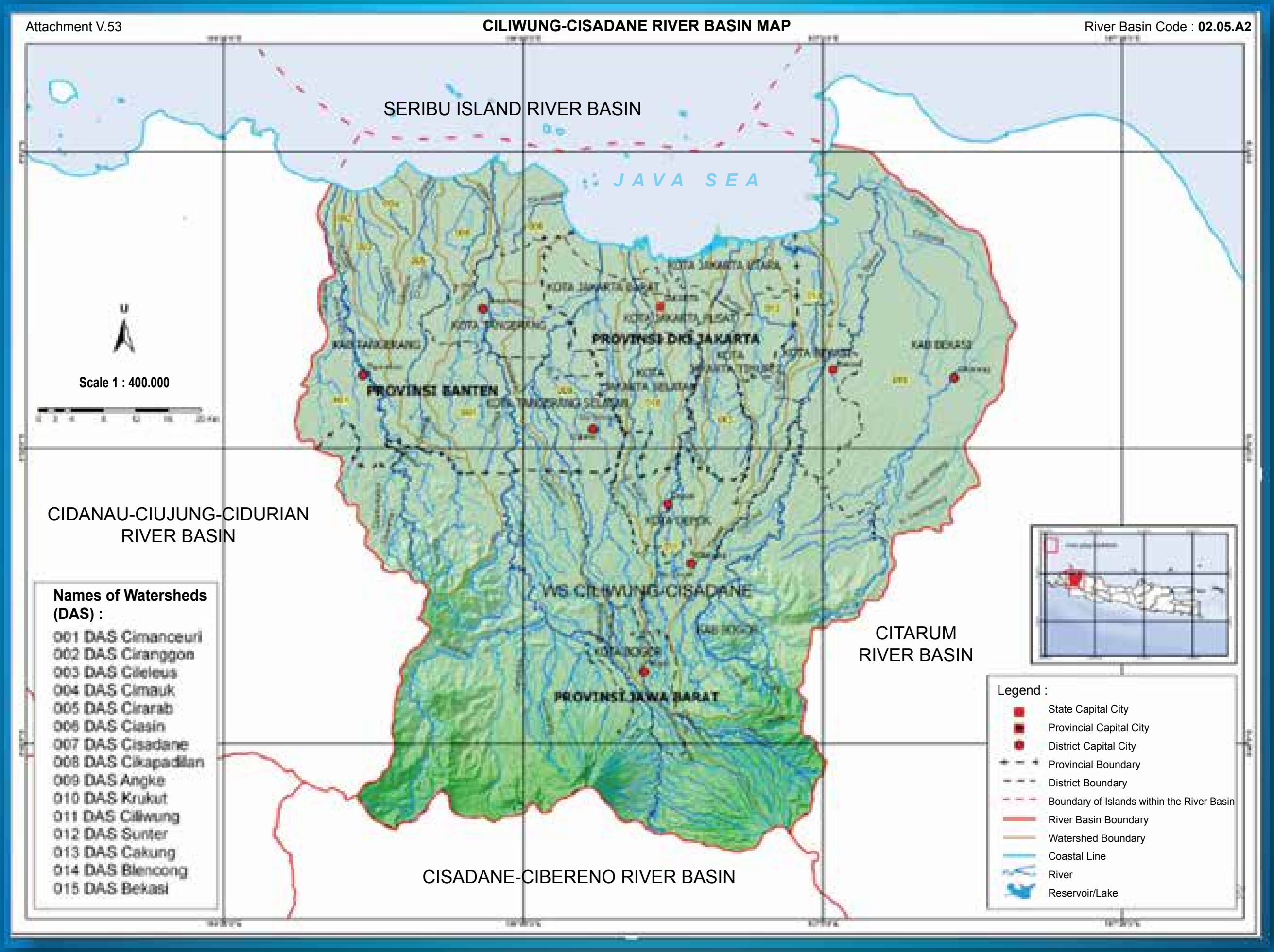
These development efforts should involve all stakeholders and take into account the operational and maintenance aspects in order to gain optimal benefits and to guarantee the sustainability of the functions.

3.5. Erosion and Sedimentation Control

Impacts of erosion in the upstream area can be seen clearly in the sedimentation that occurred in the downstream area, especially in the Segara Anakan lagoon. In general, erosion that occurs in river channels is relatively smaller than the erosion that occurs outside the river channels, including the products resulted from the Mount Galunggung eruption and in crop cultivation areas.

Therefore, efforts of erosion control need to involve various relevant agencies and community. Socialization activities or public awareness campaigns need to be done first on particular occasions or through the GNKPA forum.

B2. LARGE RIVER BASIN ORGANIZATION OF CILIWUNG-CISADANE



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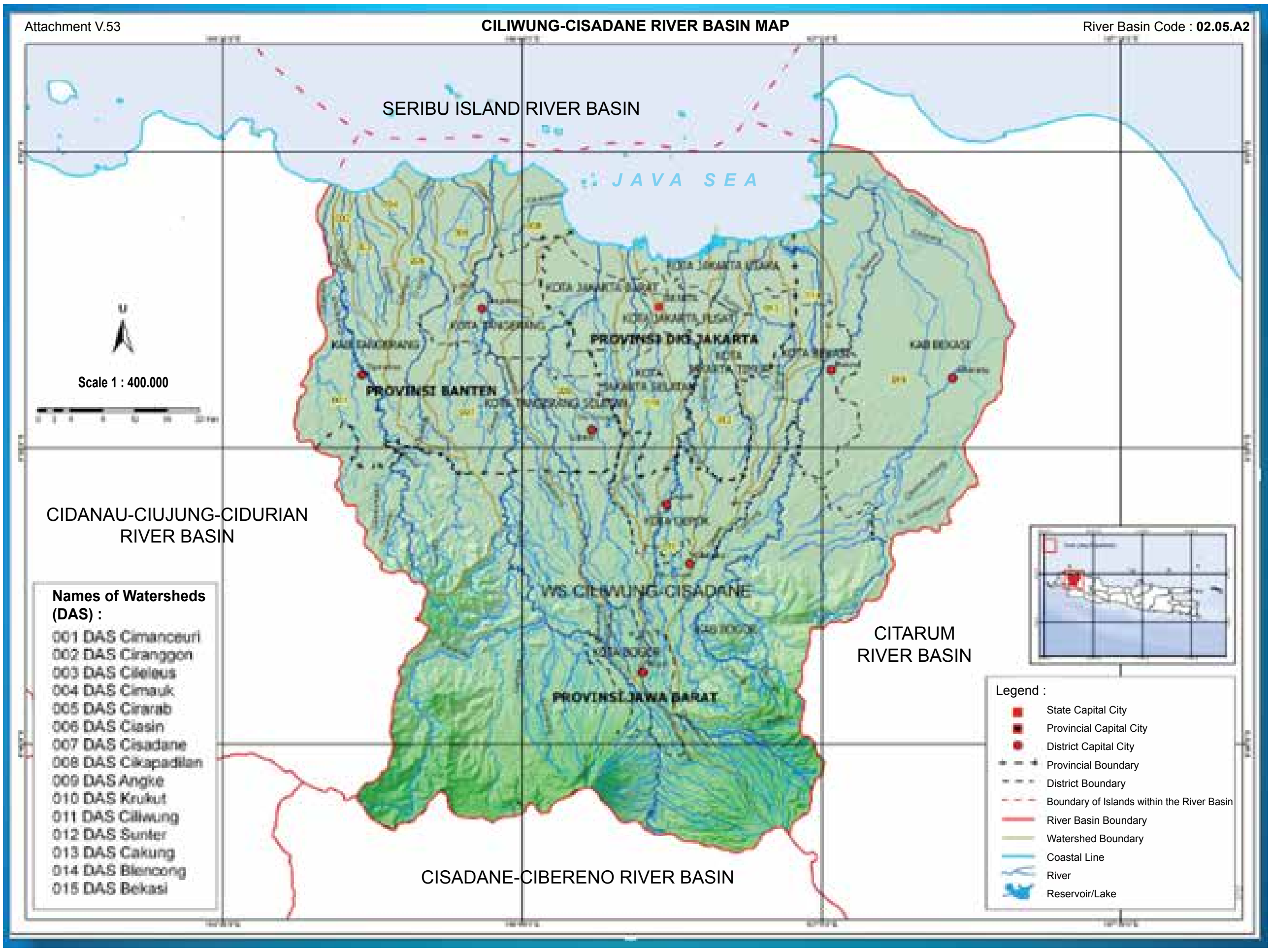


Figure 1: Work Area of BBWS Ciliwung-Cisadane

1.1. General Information

Name	:	Balai Besar Wilayah Sungai Ciliwung-Cisadane
Address	:	Jl. Inspeksi SaluranTarum Barat No. 58
Municipality	:	Jakarta13620
Telephone	:	(021) 8190210; 8190856; 8196945
Facsimile	:	(021) 8196145; 8190856
Website	:	http://.bbwsciliwungcisadane.com
E-mail	:	
Legal Basis	:	Regulation of Minister of Public Works Number 23/ PRT/M/2008
Work Area	:	Ciliwung-CisadaneRiver Basin
River Basin Classification	:	Cross-provincial River Basin
River Basin Code	:	02.10

1.2. Brief History

1965	:	Flood Prevention Project Command (KoproBanjir)
1977	:	Greater Jakarta Flood Management Project
1994	:	Master Project of Ciliwung-Cisadane River Basin Development
2008	:	Balai Besar Wilayah Sungai Ciliwung-Cisadane (Large River Basin Organization of Ciliwung-Cisadane)

The President of the Republic of Indonesia, Ir. Soekarno, issued the Republic of Indonesia Presidential Decree Number 296 of 1965 regarding "Flood Prevention Project Command in the Special Capital Region of Greater Jakarta" dated 11 February 1965. Soon afterwards, the "PROJECT COMMAND" was established. This Project Command was responsible to the President of the Republic of Indonesia c.q. the Minister of Public Works and Electric Power, and appointed as the "PROJECT COMMANDER" was Ir. Sujono Sosrodarsono.

The Balai Besar Wilayah Sungai (BBWS) Ciliwung-Cisadane is a type-B large river basin organization which organizational structure consists of:

1) Administration Department
2) Program and Planning Division
3) Implementation Division
4) Water Resources Operation and Maintenance Division

In addition, BBWS Ciliwung-Cisadane also has functionaries that serve as technical implementation units (UPT).

1.3. Human Resources

BBWS Ciliwung-Cisadane has 89 technical employees and 107 non-technical employees, making a total of 196 employees. These employees are spread in the head office as well as in the field, with details as shown in the following Table 1:

Table 1: Human Resources

Human Resource	Program & Planning Division	Implementation Division	Operation & Maintenance Division	Administration Department	Total
Engineer	?	?	?	-	89
Non Engineer	?	?	?	33	107
Total	**19**	**94**	**50**	**33**	**196**

1.4. General Condition of Work Area

a) Geography

As many as 40% or 24,000 hectares of the Special Capital Region of Jakarta Province's total area are lowlands, especially in areas such as Muarabaru, Papnggo, Warakas, etc. The elevations range from +0.50 M to +1.20 M of PP (PeilPriok). Normal sea level is around +1.40 M of PP and maximum tidal elevation is around +1.90 M of PP.

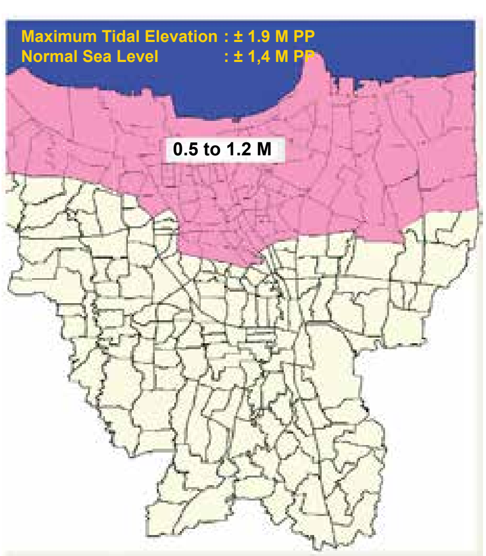


Figure 2: Geography of Jakarta

In the beginning, those areas were always inundated or were in the form of swamps, and today there are still at least 69 locations with the word 'rawa' (which means swamp) in their names, such as Rawa Belong, Rawa Mangun, RawaBebek, RawaBuaya, etc. (Gunther W. Holtrof, Jakarta-Jabodetabek Street Atlas).

Some estuaries such as Ciliwung estuary in Marina, PasarIkan, Pluit and Duri, are not always able to drain river water into the sea. In fact, sea water often enters the estuaries, especially at high tide. Due to this, tidal gates are built in those estuaries and in Pluit, a reservoir and pump were built to dispose water into the sea.

The lowlands are very susceptible to inundation because of the entering of sea water into the lands through leaking sea embankment or sea embankment that's overflowed by tides.

b) Land Subsidence

Based on the Bandung Geological Agency study results, land subsidence in the Special Capital Region of Jakarta during the period of 1982-1997 reached 180 cm (Murdohardono, 2010). Meanwhile, according to Abidin et al., land subsidence rates are 1-28 cm per year.

Table 2: Land Subsidence in Jakarta

Method	Period	Subsidence Rates (cm/year)
Leveling surveys	1982 - 1991	1 - 9
	1991 - 1997	1 - 25
GPS surveys	1997 - 2010	1 - 28
InSAR	2006 - 2007	1 - 12

Figure 3: Tidal Flood in North Jakarta on 26 November 2007

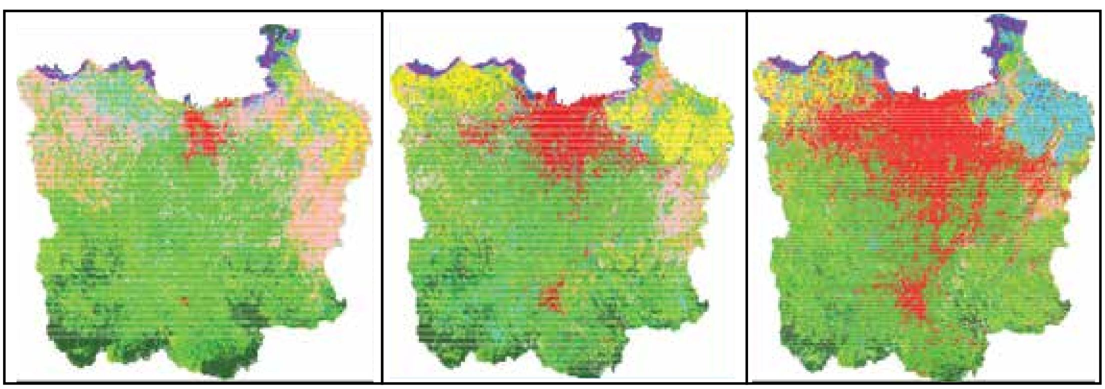
Figure 4: Map of Tidal Flood Locations in North Jakarta

Some opinions state that the occurring land subsidence is an accumulation of cramming from building or settlement loads due to natural consolidation process and land subsidence process. However, there is another opinion that stating that land subsidence is caused by high level of groundwater abstraction by industries, hotels etc., due to lack of clean water supplied by the Regional Drinking Water Company (PDAM) of Jakarta. This is currently being investigated by the Office of Industries and Energy of Jakarta. It should be noted that the clean water supply for Jakarta is only 19.4 m^3/sec, while the real requirement is around 28 m^3/sec. This water deficit is covered by deep groundwater and shallow groundwater.

The Regional Government of Jakarta attempts to slow down the rate of deep groundwater abstraction by making deep groundwater retribution tariff much higher than clean water tariff for businesses, which value is Rp12,500,-/m^3.

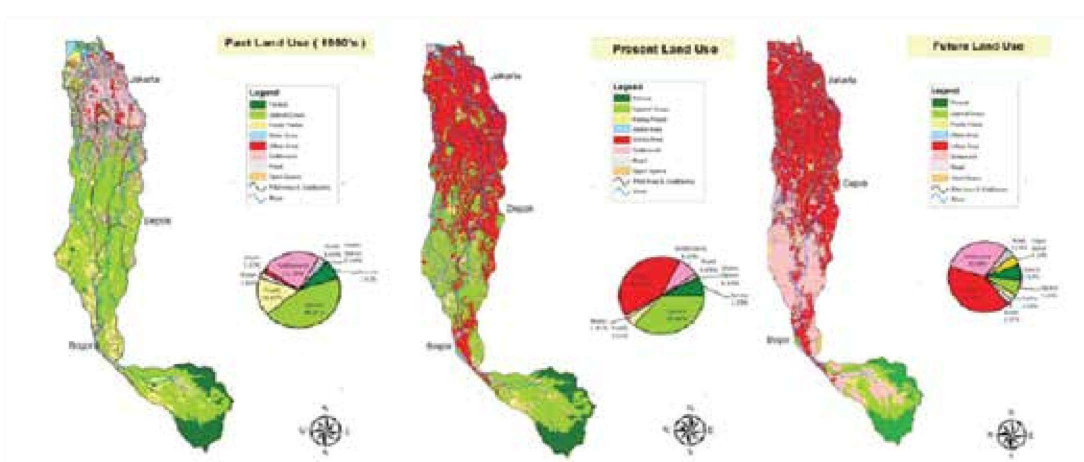
c) Land Use

Land use in Ciliwung-Cisadane River Basin has experienced a lot of changes, especially around urban areas. Many rice fields, dry fields and other open space have changed into residential areas, commercial areas, office areas and other urban infrastructures. A study conducted by the Institutional Revitalization Project for Flood Management in Jabodetabek (2008) revealed that the land-use changes resulted in increased flow coefficient from 0.60 (1980) to 0.66 (2008) and it is estimated to increase to 0.72 (2030) along with the increase of urbanization from 28.8% to 50.8% and 75.8%.



1972 1992 2005, Djakapermana, 2008

Figure 5: Land-Use Changes in Ciliwung-Cisadane River Basin



1980's	2008	Future Prospect
Urbanization 28.8%	Urbanization 50.8%	Urbanization 75.8%
Run-off Ratio f=0.6	Run-off Ratio f=0.66	Run-off Ratio f=0.72

Figure 6: Land-Use Changes in Ciliwung Watershed

One of the direct impacts brought by the land-use changes is increased run-off coefficient, as shown in the following Table 2.

Table 3: Flow Coefficient Increase

Year	1980	2008	2030
Urbanization	28.80%	50.80%	75.80%
Run-off Coefficient	0.6	0.66	0.72

As a consequence, the Ciliwung River's flood discharge increased by 49% in Depok and 57% in Manggarai.

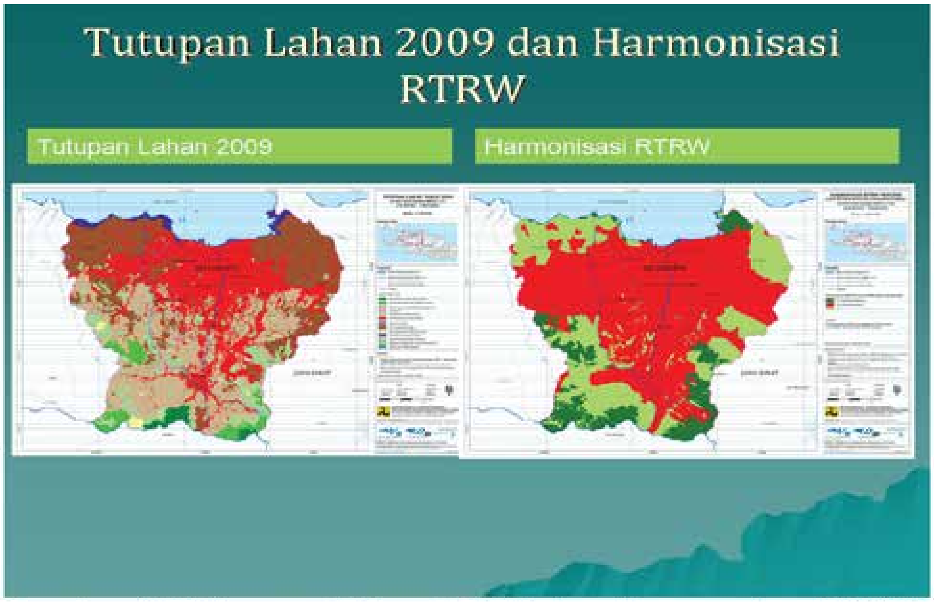


Figure 7: Land Cover in 2009 and Spatial Plan Harmonization

d) Urbanization

Figure 8: Garbage and Settlements in Rivers

Newcomers who cannot afford to occupy a decent residential area eventually set up houses at riverbanks and above river channels in many areas in almost the entire area of the Special Capital Region of Jakarta.

1.5. Hydrology

The climate in Ciliwung-Cisadane River Basin is influenced by 2 (two) seasons, namely dry season and rainy season. Temperatures range from 24°C to 35°C, with average rainfall of 2,500-3,000 mm/year.

AWLR stations, Climatological Stations, AWLR Real-Time stations, ARR Real-Time/Telemetry stations and water quality monitoring points have been built in the work area of BBWS Ciliwung-Cisadane.

1.6. Watersheds, Rivers and Tributaries

The work area of BBWS Ciliwung-Cisadane covers 3 provinces, namely West Java Province, Special Capital Region of Jakarta Province and Banten Province. It is located at 106° 23' East Longitude to 107° 40' East Longitude and 6° 8' South Latitude to 6° 12' South Latitude. There are two main rivers flowing in the Ciliwung-Cisadane area, namely Ciliwung River, which is 126 km in length, and Cisadane River, which is ±170 km in length and each river has watersheds extending to 387 km² and 1248 km² respectively.

The Ciliwung-Cisadane area, which region is called Jabodetabek, extends to 5,367 km² with a population of 22,544,637 persons. The population lives in 6 municipalities and 3 regencies, which are Jakarta Municipality as the State Capital City, Bogor Municipality, Depok Municipality, Tangerang Municipality, Bekasi Municipality, and South Tangerang Municipality, Tangerang Regency, Bogor Regency and Bekasi Regency.

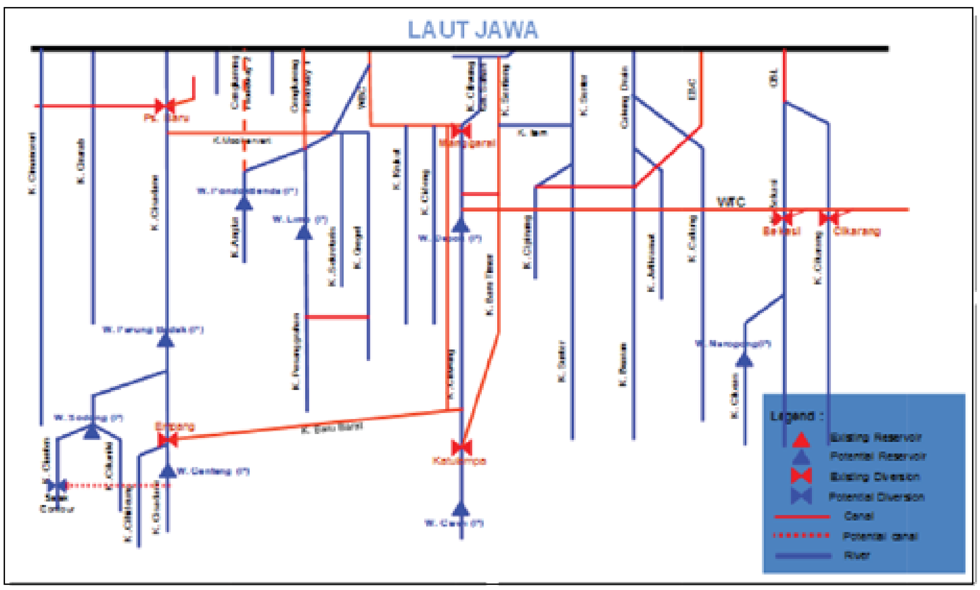


Figure 9: Ciliwung-Cisadane Rivers Scheme

However, based on the Presidential Decree Number 12 of 2012, the Ciliwung-Cisadane River Basin consists of 15 watersheds, as shown in the map on the cover page.

1.7. Budget Allocations of 2010, 2011 and 2012

Table 4: Budget Allocations

No	Year	Amount of Budget [Rp.]	Description
1	2010	232,665,009,000	APBN
2	2011	779,297,124,000	APBN
3	2012	813,064,387,000	APBN

APBN : The National Budget

1.8. Issues

The main issue in Jakarta is flood, which is a classic problem that has been happening since hundreds of years ago.

In the past, flooding occurred only in the northern part of the city, which was inhabited by merchants, laborers, and the Dutch East Indies Government-VOC.

Figure 10: Photo Series of Flood Occurrences in Jakarta

The development of commercial and trading activities has resulted in increased population, and due to this, the city was expanded toward the west, east and especially the south. This increased area of the city has resulted in more and larger locations of flood inundations.

The photos of flood occurrences above shows that the issue of flood is a serious issue that disrupts daily activities which eventually bring material loss in the form of damaged things that are submerged in water, social losses due to disconnected traffic, disrupted trading activities, schools cannot operate, public services are also disrupted, etc.

The Government's efforts to overcome flooding have been carried out since a long time ago, which take the form of reducing floods in the city, the Dutch Government diverted the Ciliwung River flow directly into the sea by building water gates and Gunung Sahari canal that led directly to the sea.

In order to protect the city against Ciliwung River's increasing flood discharge due to the conversion of rubber forests in Puncak into tea plantations, in 1920, the Dutch Government built the West Flood Canal from Manggarai toward the sea. By the Presidential Decree issued by President Soekarno, the Greater Jakarta Flood Project Command was established, led by Ir. Soeyono Sosrodarsono (1965-1968).

The efforts carried out included City Drainage improvement, river dredging, and the efforts were continued by the following Officials by compiling the 1973 Jakarta Drainage Master Plan, which served as the starting point of a comprehensive management program.

The 1973 Jakarta Drainage Master Plan recommended the following:

1) Extension of West Flood Canal trace from Karet water gate toward the west through Slipi, Tanjung Duren, and Angke. However, this concept was canceled due to a problem in land clearing, and the fucntion was replaced by the construction of Cengkareng Drain that cut the flows of Pesanggrahan River, Angke River, Speak River and Mookervaart River directly into the sea, and the construction of Siantar Pump in Tomang area to overcome flooding on JalanThamrin.

2) Construction of Cakung Drain to overcome flooding in east of Jakarta.

3) Construction of polders in Pluit, West and East Setiabudi, Tomang, Grogol, Sunter, etc.

4) Construction of East Flood Canal, which realization was implemented in stages, starting in 2003 and completed in 2012.

Table 5: Flood Discharge Increase in Ciliwung River

No	YEAR	DESIGN Discharge (m³/second)
1	1918	280
2	1973	370
3	1997	570
4	2007	800

In addition, water resources management in Ciliwung-Cisadane River Basin also faces many other issues related to the sustainability of water resources in the upper part of Ciliwung-Cisadane River Basin, namely:

1) Forest areas and conditions continue to decline. The forest damages have brought a wide impact, which is ecosystem damage in river basin arrangement, and this condition is also encouraged by poorly coordinated river basin management between the upstream and the downstream and also the institutions are still weak.

2) Low capacity of forest management, funding, facilities & infrastructures, institutions, and incentives for forest management.

3) The people's awareness in maintaining the environment is still low. This is evidenced by how the areas of forests in Puncak have been decreasing and they have been turned into villas which many of them are said to be owned by Jakarta residents. The Regional Government of Bogor have conducted many efforts, such as issuing the Regional Regulation concerning Restriction on Settlement in Puncak, but many villas still continue to grow sporadically. In fact, new villas have recently emerged on the slopes of Mount Salak and Mount Pangrango. The Regional Government of Bogor has also started controlling the emergence of those villas.

The level of erosion and sedimentation is relatively high, especially in upper Bekasi watershed due to forests being cleared and converted into settlements and farming lands that do not comply with conservation norms. The same condition also occurs in the upper Ciliwung watershed and the upper Cisadane watershed.

Based on the study conducted by the Citarum-Ciliwung Watershed Management Office, the area of very critical watersheds in Ciliwung-Cisadane River Basin extends to 802 ha, critical watersheds 17,219 ha, rather critical watersheds 81,407 ha, and potentially critical watersheds 244,504 ha. The conditions of Ciliwung Watershed and Bekasi Watershed at the midstream and downstream areas are relatively stable and the danger level of erosion and sedimentation is relatively low.

Water Quality

The dominant sources of pollution that pollute the Ciliwung River and Cisadane River are as follows:

- Industrial waste

  In Ciliwung-Cisadane River Basin, there are many industries that dispose their waste directly into rivers without processing it beforehand. Although there is already a regulation that requires every industry to process its liquid waste before disposing it into the river, in reality this regulation is not being adhered to.

- Domestic waste

  Domestic waste (households, hotels, restaurants, etc) is the largest source of pollution.

- Issues in pollution control

  Issues encountered in the efforts of controlling pollution in Ciliwung-Cisadane River Basin include:

  - Since the implementation of the Clean River Program, control has been carried out only on industrial waste. Domestic waste control has not been carried out, when in fact researches show that the load of domestic waste reach 62% of the total loads that enter into rivers.
  - 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 (/IPAL) 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.

2. WATER RESOURCES MANAGEMENT

The water resources management in Ciliwung-Cisadane River Basin was initially carried out primarily as an attempt to control flooding based on the Flood Control Master Plan which consisted of:

- Stage 1: The 1973 Master Plan for Drainage of Jakarta, NEDECO, the flood management plan for Jakarta was focused on West Flood Canal, East Flood Canal, Cakung Drain, city drainage and development of polders in low areas.
- Stage 2: The 1977 Second Master Plan, The Study on Comprehensive River Water Management Plan in JABODETABEK Area, Japan's Nikken Consultant, which was focused on the normalization of 21 rivers in Ciliwung-Cisadane River Basin, located in Tangerang, Jakarta, Bogor and Bekasi, with design discharge between Q25 and Q100 per year.

In accordance with Law Number 7 of 2004 regarding Water Resoruces, the management of water resources must be based on a management model which preparation must involve all stakeholders, including efforts to empower, monitor and involve the community through the Water Resources Management Coordination Team (TKPSDA). Due to this, in 2010, the 6 Ci's River Basins Management Model was prepared based on the Decree of Minister of Public Works Number 11A/06, which combined 3 (three) areas, namely CitarummCiliwung-Cisadane and Ciujung-Cidurian, by taking into consideration the various aspects of management and not only the efforts of flood control and irrigation, but also water resources conservation, water resources information system and community involvement.

However, according to the Presidential Decree Number 12 of 2012, the 6 Ci's River Basins were changed and split into 3 (three) river basins, namely Cidanau-Ciujung-Cidurian River Basin, Ciliwung-Cisadane River Basin and Citarum River Basin.

2.1. Water Resources Conservation

The fact of how the condition of water catchment areas continues to decline with an indication of increased critical lands and forest damages as well as a decline in water quality in Ciliwung-Cisadane River Basin needs to be followed up with activities of conservation, both physical anf non-physical, in order to maintain the sustainability of water resources' existence, carrying capacity, assimilative capacity and functions.

Soil and Water Resources Conservation in Ciliwung-Cisadane River Basin

- Vegetative Conservation, carried out by means of Multiple Cropping and Reforestation.
- Mechanical Conservation, which includes: Soil Tillage According to Contour; Terraces, Infiltration Wells; and Check-dams/Gully Plugs.

Plans related to Ciliwung-Cisadane River Basin Conservation

Forest and Land Rehabilitation will be carried out by the Watershed Management Office and the Regional Government on areas with environmental damages, especially at the upper part of river basin as a water catchment area.

For land and water resources conservation in Ciliwung-Cisadane River Basin, the BBWS Ciliwung-Cisadane have rehabilitated artificial lakes and constructed channel reservoirs. Out of all artificial lakes in Jabodetabek, which amount to around 200 lakes, as many as 50 artificial lakes have been rehabilitated in phases, and around 15 channel reservoirs have also been built.

Figure 11: Map of Technical Plan of Forest and Land Rehabilitation of Ciliwung-Cisadane Watershed Management Office

Figure 12: Artificial Lake Before and After Rehabilitation

Figure 13: Small Check-dam

2.2. Water Resources Utilization

2.2.1. Water Resources Use

The resources in Ciliwung-Cisadane River Basin area used for meeting various requirements such as irrigation, raw water for drinking water and industries, as well as flushing. There are many industries that use the water allocation in the Ciliwung-Cisadane River Basin, especially along Cisadane River and Ciliwung River.

The Regional Drinking Water Company (PDAM) processes the CisadaneRiver's water for meeting the drinking water requirement of Jakarta in an amount of 3 m^3/sec, Tangerang Municipality/Regency in an amount of 5.10 m^3/sec and Bogor Municipalityin an amount of 3.80 m^3/second(including water abstraction from the CiliwungRiver).

The Regional Drinking Water Company (PDAM) uses the water from Krukut River in an amount of 0.40 m^3/second.

To meet Jakarta's drinking water requirement, the Regional Drinking Water Company (PDAM) of Jakarta buys raw water from Jatiluhur Reservoir which is channeled through the west Tarum channel in an amount of 16 m^3/second. However, Jakarta still requires more clean water, especially for industries and tourism, and to meet this requirement, they use deep groundwater.

Water Requirement Analysis

- Irrigation Water Requirement

  Based on the current condition, irrigation areas in Ciliwung-Cisadane River Basin, according to data of 2009, extend to 86694 hectares, consisting of Cisadane Irrigation, Jatiluhur Irrigation and Ciliwung Irrigation.

- Domestic and Non-domestic (Household and Urban) Water Requirements

  Water requirement is calculated based on the number of population. The amounts of domestic and non-domestic water requirements are calculated based on the provision set by the Directorate General of Human Settlements. The water requirement for a metropolitan-size city is 190 liter/person/day and for a medium-size city is 130 liter/person/day.

  The ideal domestic and non-domestic water requirements that need to be met in 2030 for the Metropolitan City of Jakarta amount to 41.60 m^3/sec, for Tangerang municipality and regency 19.70 m^3/sec, for Bogor municipality and regency 18.80 m^3/sec, and for Bekasimunicipality and regency 15m^3/sec.

- Industrial Water Requirement

  The calculation of industrial water requirement in Ciliwung-Cisadane River Basin for industries located in BODETABEK (Bogor, Depok, Tangerang, and Bekasi) uses river water, but industries in Jakarta use deep groundwater because the rivers' water is highly polluted and the amount is very small.

- Fishpond Water Requirement

  Fishponds in Ciliwung-Cisadane River Basin cover a total area of 15,095 hectares (2009), and most of these fishponds are located near coastal areas. The amount of water requirement for fishponds until 2030 is assumed to stay the same, which is 1 liter/second/hectare.

2.2.2. Water Resources Development

In order to meet Jakarta's water requirements that still experience a deficit, attempts have been made for the treatment of river water in Jakarta, which is very dirty, by using the ultra-filtration technology. This will be developed in the West Flood Canal, Jembatan Besi (2 m³/sec) and in Cengkareng Drain (1 m³/sec). In addition, attempts have also been made to develop a technology of sea water treatment by way of desalination, which has been started by Jaya Ancol. The production costs of these two technologies are very high. However, compared to Jakarta's clean water price for industries, which is Rp 12,500,-, the production costs for desalination and ultra-filtration are still cheaper, which are Rp 9,000,- and Rp 5,000,- respectively.

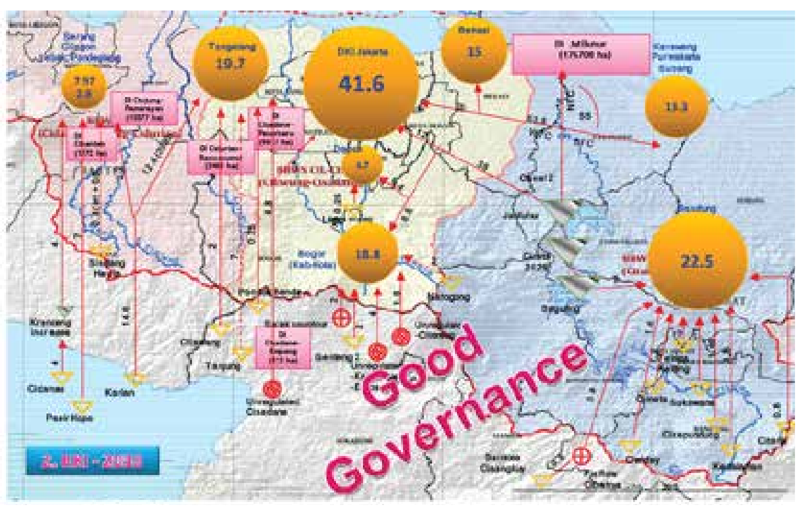


Figure 14: Raw Water Requirement & Fulfillment Scheme of JABODETABEK (Jakarta-Bogor-Depok-Tangerang-Bekasi) in 2030

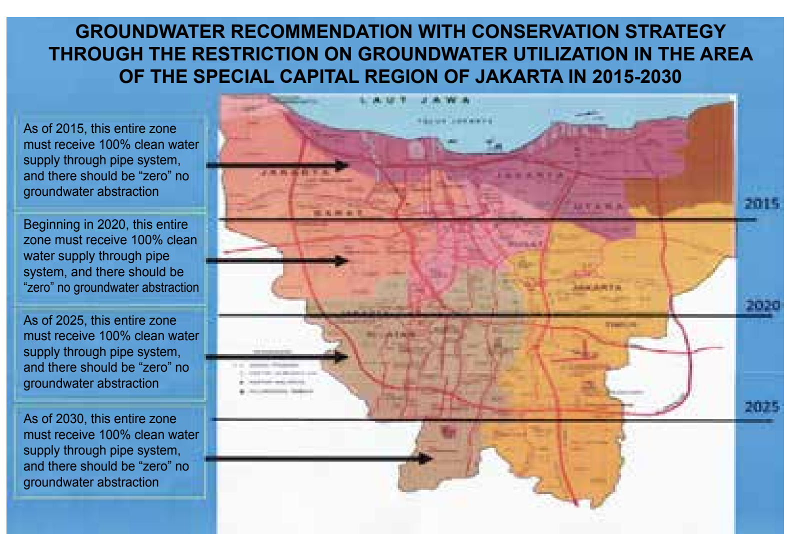


Figure 15: Jakarta Drinking Water Supply Plan

Table 6: Technical Irrigation

No	Irrigation Area	Regency	Area (Ha)	Network Level
Authority of Central Government				
1	Northwest Cisadane	Tangerang	10,379	Technical
2	West Cisadane	Tangerang	9,198	Technical
3	North Cisadane	Tangerang	2,476	Technical
Total			**22,053**	
Authority of Provincial Government				
1	Kranji	Bogor	53	Technical
2	Cibanon	Bogor	456	Technical
3	Sasak	Bogor	1,072	Technical
4	Katulampa	Bogor	333	Technical
5	BantarJati	Bogor	24	Technical
6	Cibalok	Bogor	79	Technical
7	ParakanJati	Bogor	119	Technical
8	Empang	Bogor	1,057	Technical
9	Angke V	Bogor	252	Technical
Total			**3,445**	

2.3. Control of Water Destructive Power

2.3.1. Flood Management Principles

Flood management in Ciliwung-Cisadane River Basin is carried out with a comprehensive management principle, which is the flood from the upstream is channeled to the West Flood Canal and East Flood Canal to be directly disposed into the sea. For rainwater that falls on a city located on a relatively high area, the water, with gravity, is channeled through drainage canal into the river and then into the sea, while rainwater that falls on a low area and cannot be directly disposed into the sea is channeled into reservoirs/ polders and then pumped into the river and channeled into the sea. Such as in Figure 16 that describes the principles of Jakarta Flood Management according to the 1973 Jakarta Flood Management Master Plan.

For instance, the flow of flood in Ciliwung River in Manggarai is diverted into the West Flood Canal straight into the sea.

The same goes for floods in Cipinang River, Sunter River, Buaran River, Jatikramat River and Cakung River, in which the floods in these rivers are channeled into the East Flood Canal and then disposed directly into the sea.

In line with the development of Jakarta, which is accompanied with the development in flood management by constructing flood management infrastructures, the principles for flood management therefore change also, such as shown in Figure 17 where we can see that there are the Cengkareng Drain, East Flood Canal and the Cengkareng Floodway II plan, as well as the management of artificial lakes in the upstream area.

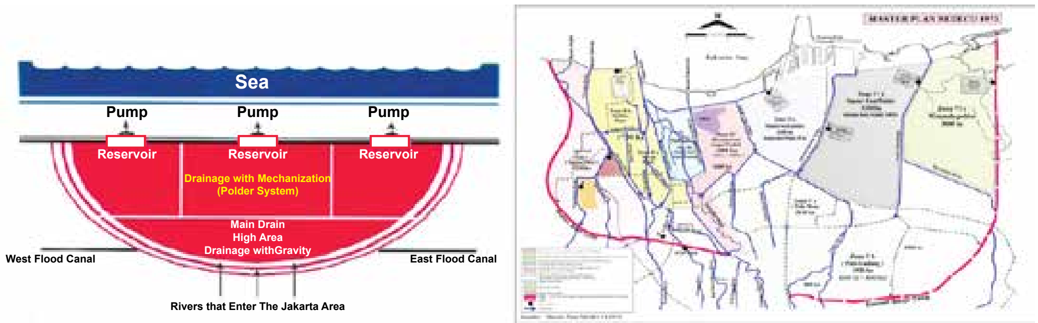


Figure 16: Jakarta Flood Management and Drainage System

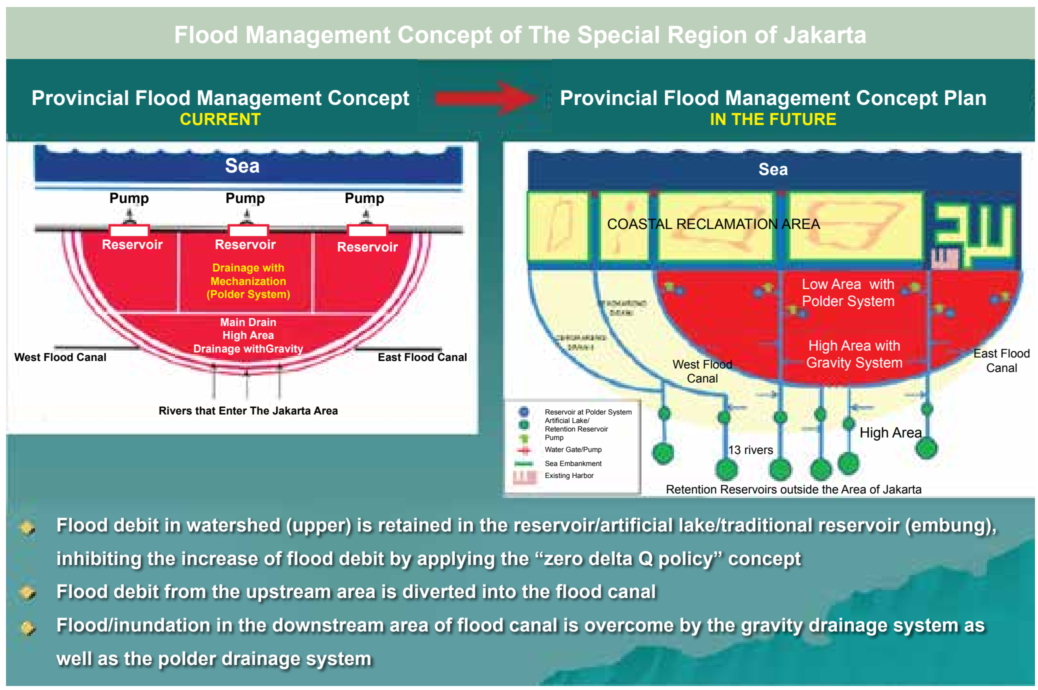


Figure 17: Development of Flood Management Principles

Figure 18: West Flood Canal Normalization

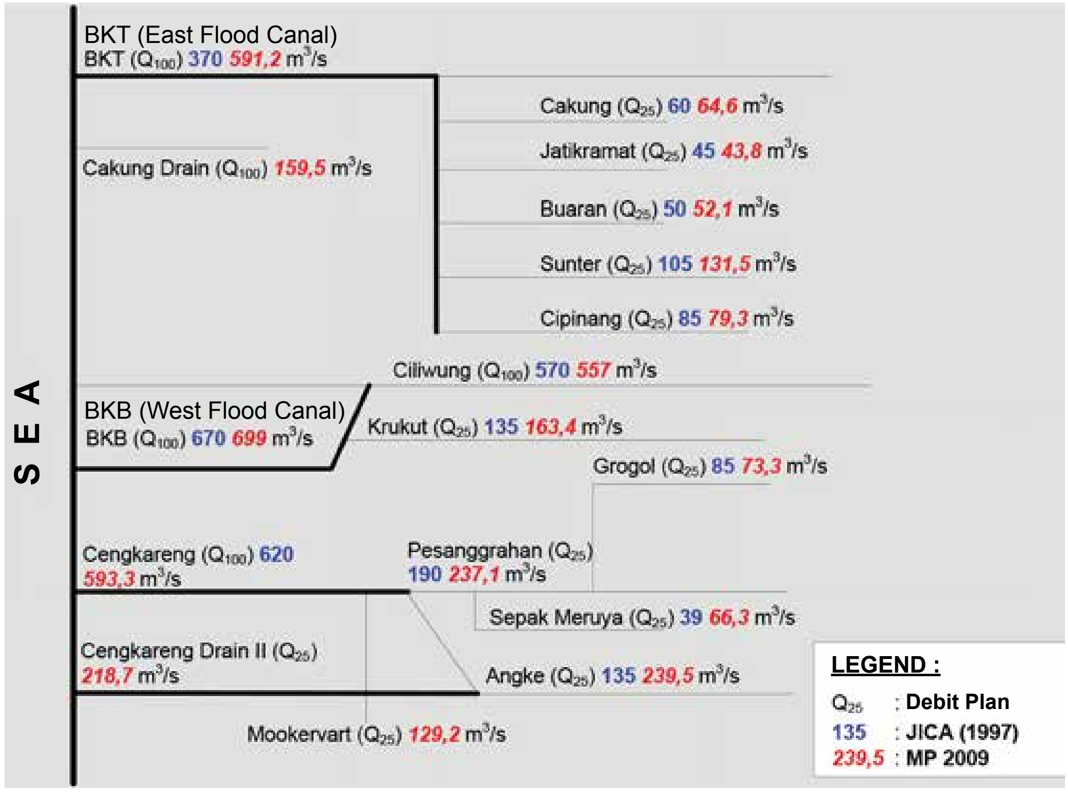


Figure 19: River Design Discharge (MP Review, 2009)

2.3.2. Tidal Flood

In the past few years, there have been occurrences of floods caused by high tides and also land subsidence in the north coast of Jakarta. The worst incidence was in 2007 in Pluit, which knocked down the Pluit Pump's walls and causing floods in Muara Baru and Luar Batang. Areas affected by the tidal flood in North Jakarta were KapukMuara, Kamal Muara, Pluit, Penjaringan, Cilincing and Marunda.

Figure 20: Tidal Rob Management in Jakarta, Tangerang&Bekasi

2.4. Water Resources Information System

One of the functions of BBWS Ciliwung-Cisadane is hydrological system management. In order to support the function and responsibility, a hydrological system needs to be implemented which consists of hydrological system facilities and infrastructures as well as their management units. The hydrological system is under the Operation and Maintenance Division of the Large River Basin Organization of Ciliwung-Cisadane. The Operation and Maintenance Division implements the following functions:

a) Operation and maintenance of rivers, lakes, artificial lakes, as well as the facilities and infrastructures

b) Monitoring and evaluation of operational feasibility on facilities and infrastructures

c) Preparation of technical recommendations in the licensing for the provision, allocation, use and exploitation of water resources in river basin

d) Implementation of hydrological and water resources information system

e) Facilitation in Water Resources Management Coordination activities in river basin and community empowerment in water resources management

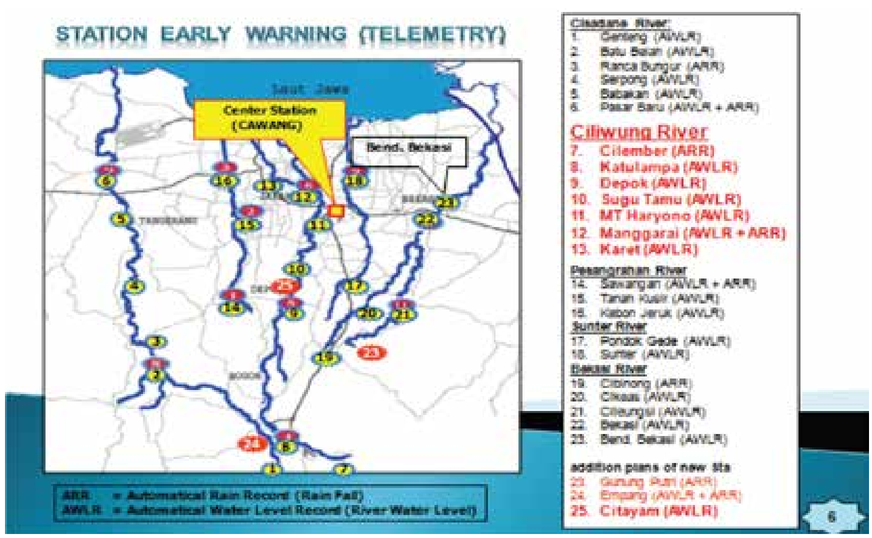


Figure 21: Flood Early Warning Stations Map

The equipment available in Ciliwung-Cisadane, especially automatic rain recorders, automatic water level recorders (AWLR)are installed in certain rivers. In addition, there are flood monitoring stations in strategic water level monitoring locations which data are sent to the Central Command Post in the BBWS Ciliwung-Cisadane Office through the radio or automatically by using the Scada equipment.

2.5. Community Empowerment and Participation

Community empowerment is carried out through:

The Water Resources Management Coordination Team (TKPSDA). The members of TKPSDA consist of:

a) Central Government
b) Provincial Government
c) Regency Government
d) NGOs
e) Professionals
f) Association of Engineering Experts, etc

The membership of TKPSDA is validated by the Minister of Public Works.

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. Conservation

The rapid development of settlements in JABODETABEK has led to the conversion of many artificial lakes into settlements. Therefore, artificial lakes in JABODETABEK that have not been protected need to be protected immediately and rehabilitation needs to be carried out in order to optimize the artificial lakes' functions.

Critical watershed management should also be immediately carried out by relevant agencies in relation to reforestation in order to prevent land erosion and to enable water to be stored in ground so that peak discharge can be reduced and discharge can be increased in the dry season. Construction of infiltration wells and biopores for water conservation also need to be encouraged.

3.2. Water Resources Utilization Development

3.2.1. Water Resources Development

Water resources development intended for increasing the benefits of water resources' functions in order to meet raw water requirement is planned to be implemented by preparing a master plan for the development and maintenance of water resources in Ciliwung-Cisadane River Basin.

The surface raw water deficit for Jakarta that has been going on for a long time can be overcome immediately by increasing the water discharge of the West Tarum canal from 16 m^3/second to 31 m^3/second. The PDAM of Jakarta will use the ultra-filtration technology for treating dirty water in Jakarta's rivers. The initial step will start in the West Flood Canal and Cengkareng Drain. If it is successful, it can be developed in other rivers, and therefore will increase Jakarta's water sustainability.

In addition, sea water desalination will also be developed. At present, Pembangunan Jaya Ancol has conducted seawater treatment for drinking water and in the near future, this will be developed in industries located near coastal areas.

3.2.2. Water Resources Exploitation

Water resources exploitation is regulated by the issuance of regional regulation that arranges the use of water for industries and the licensing for bottled water industries and water refilling industries with regard to social functions and environmental preservation. Every day there are many trucks carrying water from Bogor and Sukabumi. This certainly needs to be controlled in the future. The abstraction amount should not exceed the amount available in order to prevent over-abstraction which will lead to water shortage for the surrounding community. Aside from that, there is also the danger of land subsidence, which at the moment has already occurred in Bogor.

3.3. Control of Water Destructive Power

Attempts to prevent flood disaster are carried out through an integrated and comprehensive control of water destructive power planning in water resources management model that is implemented by involving the community as follows:

- Flood management by establishing flood-prone zones in the locations experience flooding almost every year. In Jakarta there are 86 inundation-prone locations.
- Restoring the function of riverbanks and riparian areas as conservation areas by limiting development in riverbanks and moving riverbank settlers out of the location.
- Increasing river capacity through river improvement and normalization from the upstream to the estuary in 21 rivers in Jabodetabek, such as in Cimanceuri, Cirarab, Cisadane, Cengkareng Drain, Angke, Pesanggrahan, Sepak, Grogol, Sekretaris, Krukut, Cideng,

Ciliwung, Cipinang, Sunter, Buaran, Jatikramat, Cakung, Blencong, Bekasi, Cikarang, and Cilemahabang.

- Increasing the number of retention basins/polders in Jakarta into 30 locations.
- Normalization of city drainage canal.
- Routine operation and maintenance of rivers and drainage canals.
- Preparing a flood evacuation system and conducting flood simulation once a year.
- Developing an early warning system by installing telemetry station/Flood Forecasting & Warning System (FFWS).
- Aligning conservation efforts in the upstream with utilization in the downstream.
- Maintaining coastlines by constructing abrasion retaining embankments or by planting mangrove on the beaches of Bekasi and Tangerang municipalities.

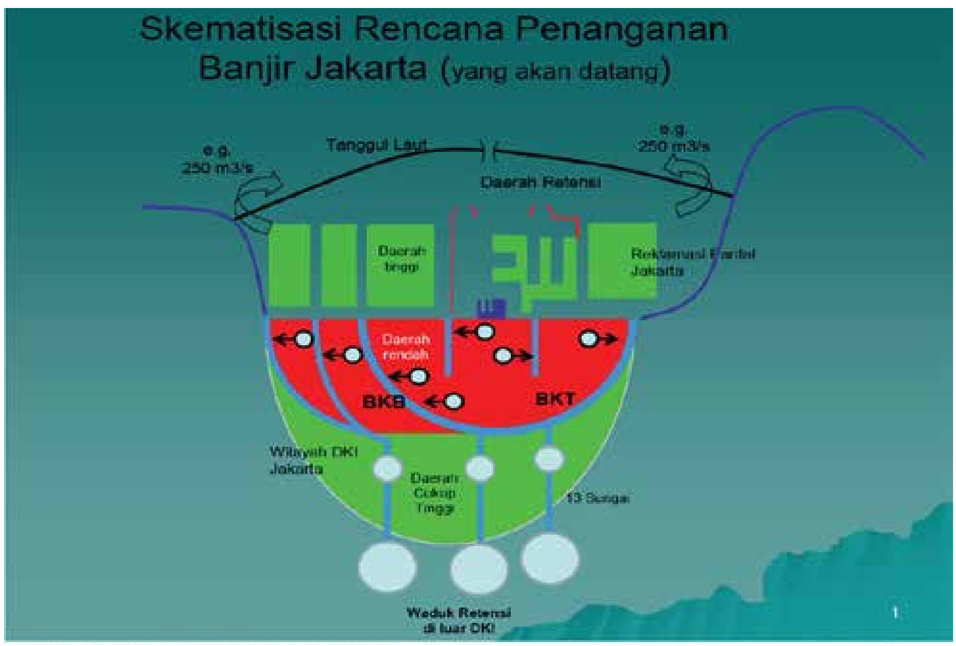


Figure 22: Future Flood Management Scheme

In addition, the Government conducts a study called the Jakarta Coastal Defence Strategy to ancipate tidal flood and land subsidence due to excessive groundwater abstraction.

The principle is to construct a massive sea embankment on the North Coast of Jakarta in order to prevent tides from entering Jakarta.

3.4. Water Resources Information System

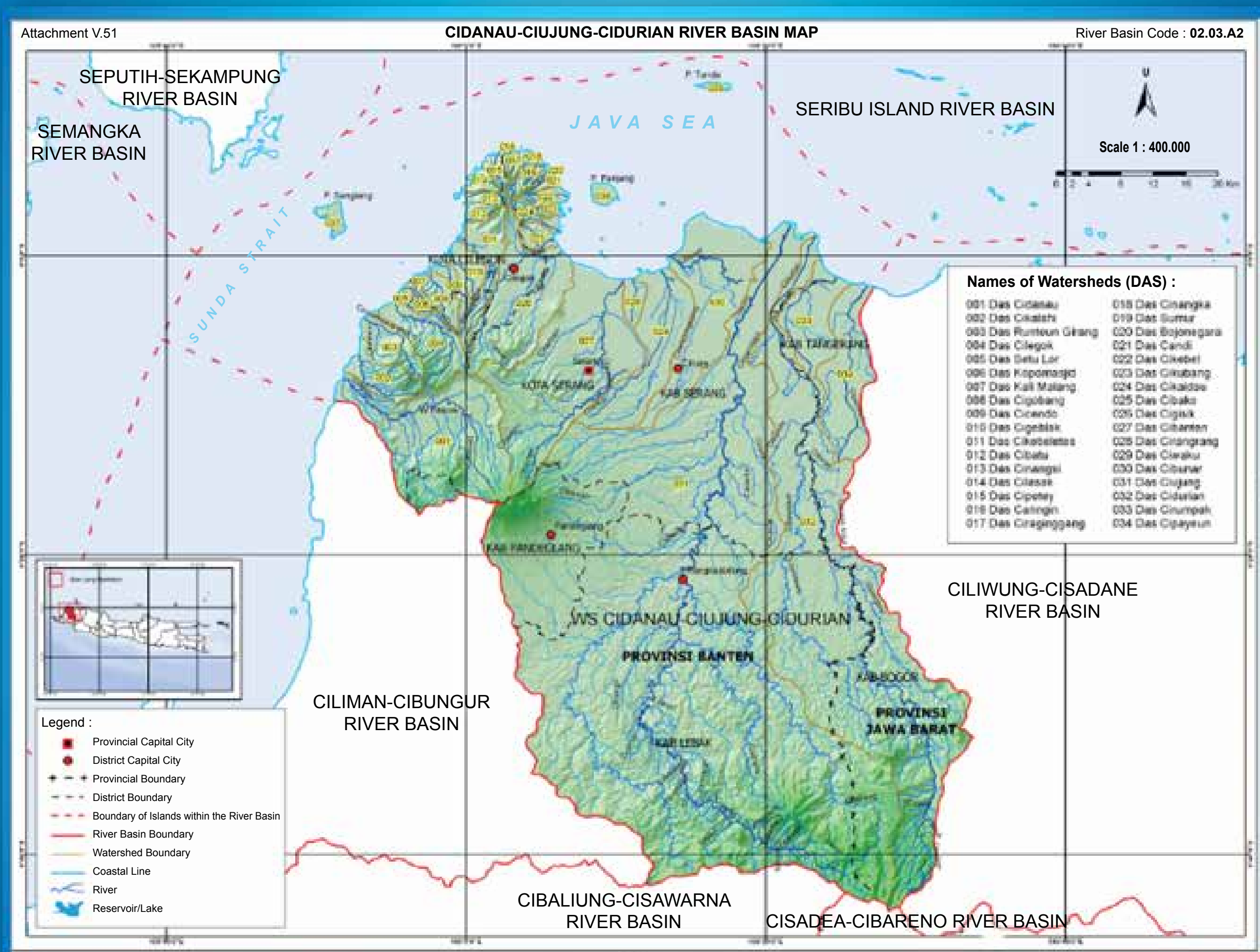
In order to support water resources management, it is necessary to provide accurate, timely, continuous and easy-to-access water resources data and information by developing a provincial or regency/municipal water resources data and information system network for Ciliwung-Cisadane River Basin that is integrated and supported by strong institutions, developing community participation in providing information on water resources as well as managing and developing the Ciliwung-Cisadane River Basin database system.

3.5. Community, Private Sector and Regional Government Empowerment and Participation Improvement

Efforts to empower and increase the participation of the community, private sector and the regional government are carried out by:

- Conducting socialization to increase the community's awareness on water resources management
- Establishing a Water Resources Council
- Enforcing law against illegal mining
- Empowering the community living around forests to participate in maintaining and safeguarding the forests
- Drawing up policies on water usage by arranging policies for overcoming water scarcity
- Increasing community capacity and active participation by increasing the organization's capacity to respond to environmental issues through assistance program provided by the government, empowering the community and the private sector through socializations, trainings, assistance and guidance, in order for them to be concerned, participate, and be responsible in sustainable water resources management.

B3. LARGE RIVER BASIN ORGANIZATION OF CIDANAU-CIUJUNG-CIDURIAN



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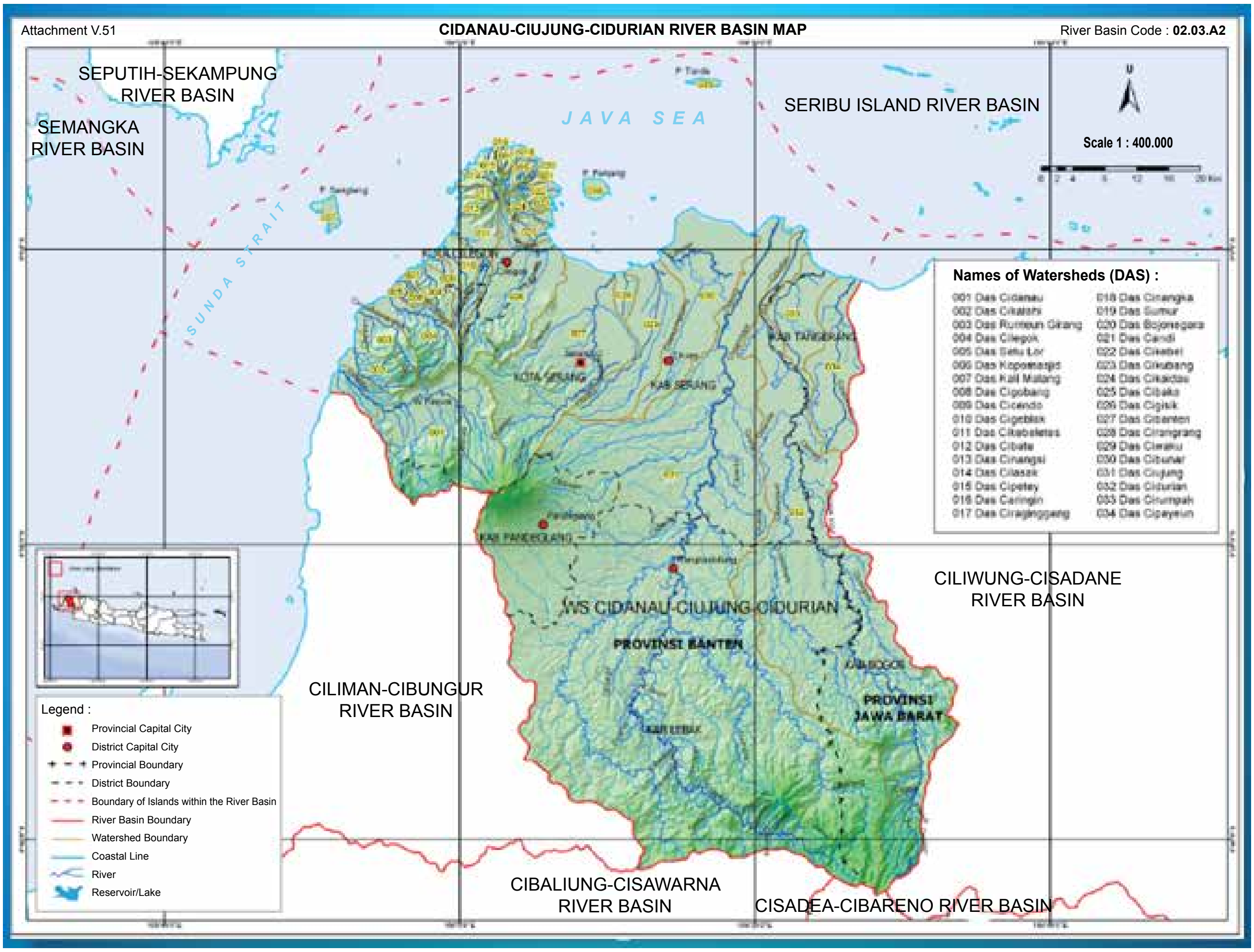


Figure 1: Cidanau-Ciujung-Cidurian River Basin

1.1. General Information

Name	:	Balai Besar Wilayah Sungai Cidanau-Ciujung-Cidurian
Address	:	Jl. Raya Labuhan Km. 3 KotakPos 8
Municipality	:	Pandeglang
Telephone	:	(0253) 201155
Facsimile	:	(0253) 202686, (0254) 206111
Website	:	http://.bbwsc3.com
E-mail	:	
Legal Basis	:	Regulation of Minister of Public Works Number 23/ PRT/M/2008
Work Area	:	Cidanau-Ciujung-Cidurian River Basin
River Basin Code	:	02.03.A2
River Basin Classification	:	Cross-provincial River Basin (West Java Province and Banten Province)

1.2. Brief History

1. 1994: Master Project for Ciujung-Ciliman River Basin Development and Banten Irrigation Work Unit

2. 2006: Balai Besar Wilayah Sungai Cidanau-Ciujung-Cidurian (Large River Basin Organization of Cidanau-Ciujung-Cidurian) in Banten Province and some parts of West Java Province

The establishment of Balai Besar Wilayah Sungai Cidanau-Ciujung-Cidurian was the continuity of the programs carried out by several work units, namely:

- Banten Irrigation Work Unit
- Flood Management and Coastal Improvement Work Unit
- Raw Water Provision Work Unit
- Ciujung-Ciliman Water Sources Development and Management Work Unit

1.3. Human Resources

The organizational structure of Balai Besar Wilayah Sungai (BBWS)Cidanau-Ciujung-Cidurian was established based on the Regulation of Minister of Public Works Number 26/PRT/M/2006, and in accordance with its category as a type-B large river basin organization, BBWS Cidanau-Ciujung-Cidurian is led by an Echelon IIB official as the head of the organization, assisted by three division heads and one department head, each being an Echelon III officials, as follows:

1) Administration Department
2) Maintenance Planning and Operation Division
3) Water Source Network Implementation Division
4) Water Utilization Implementation Division

This BBWS C-3 is supported by 205 employees, consisting of 72 technical workers and 133 non-technical workers, with details as shown in the following Table 1:

Table 1: Human Resources

Human Resource	Planning Division	Implementation Division	Operation & Maintenance Division	Others	Total
Engineer	11	50	9	2	72
Non Engineer	10	77	24	22	133
Total	**21**	**127**	**33**	**24**	**205**

1.4. General Condition of Work Area

The work area of BBWS Cidanau-Ciujung-Cidurian includes some parts of Banten Province, namely Pandeglang Regency, Lebak Regency, Serang Regency, Serang Municipality, Cilegon Municipality, as well as some parts of Tangerang Regency; and some parts of West Java Province, which are some parts of Bogor Regency.

The administrative area of Cidanau-Ciujung-Cidurian River Basin extends to 9.361,80 km². The number of population in Cidanau-Ciujung-Cidurian River Basin is 4.545.407 persons (male: 2.381.782 persons and female: 2.263.735 persons).

The distribution of employment of productive-age population is as follows:

- Agricultural sector 24,38%
- Agricultural sector 20,07%
- Service sector 66,67%

Some of the rivers in the work area of BBWS Cidanau-Ciujung-Cidurian are in polluted condition, as suggested by the Head of Domestic Waste, Toxic and Hazardous Materials, and Toxic and Hazardous Materials Waste Sub-Division of Bantan Province Environmental Agency, who explained in a media that the polluted rivers include the Ciliman River, Cirarap River, Cidurian River, Cimanceri River, Ciujung River, Cibanten River, Cidanau River, Ciujung Kulon River, Cibaliung River, Ciberang River, and Cisadane River. Due to the pollution, the quality of the polluted rivers' water no longer meets the quality standards for drinking water, agriculture, and industries.

The Cidanau-Ciujung-Cidurian River Basin consists of 3 sub-river basins, namely:

1) Cidanau Sub-river basin, with watershed areas extending to 207.7 km²
2) Ciujung Sub-river basin, with watershed areas extending to 1,987 km²
3) Cidurian Sub-river basin, with watershed areas extending to 928 km²

- The Cidanau River is the only river that channels water from Danau Swamp to the sea in Sunda Strait. Danau Swamp is a swamp located on a mountain and it receives its water supply from around 17 rivers and tributaries spread in the administrative area of Serang Regency and Pandeglang Regency. The water catchment area from the rivers, tributaries and lakes extend to 22.620 hectares, consisting of community land and the national forest area that serves as a "conservation forest". The water is highly needed by the Cilegon industrial zone, which puts this river in an important and strategic position in the national industrial sector.

- The Ciujung River is the largest river in Banten Province that passes through 2 regencies, namely Lebak Regency and Serang Regency. The Ciujung Sub-river basin consists of three main tributaries, namely Cisimeut River with sub-watershed area extending to 458 km², Ciberang River with sub-watershed area extending to 304 km², and Upper Ciujung River with sub-watershed area extending to 594 km². Other smaller tributaries are located in the downstream part of Rangkasbitung Municipality, namely Cikambuy River, Cisangu River, Ciasem River, Cibongor River and Ciyapah River.

  The Ciujung River stretches ±142 km in length. There is a weir called Pamarayan Weir which function is to irrigate the Ciujung Irrigation Area. Physical construction of a new irrigation network did not begin until 1905. The main structure of this irrigation is a weir located near the Pamarayan Village in Ciujung River. Since this structure was called the Pamarayan Wier, the irrigation network was then also called the Ciujung Pamarayan irrigation. The new Pamarayan Barrage is located in Serang Regency, Banten Province. The barrage was built in 1992.

  The almost deforested land along the river basin, massive erosion during rain, the silting up of rivers due to sedimentation, and dense settlements in riverbanks are the factors that cause flooding in the Ciujung Watershed, Banten.

  The frequently flooded regencies/municipalities in Banten are Lebak, Pandeglang, Serang, Cilegon and Tangerang. The Jakarta-MerakToll Road is recorded to have been flooded as many as seven times since 1996.

  The Karian Reservoir at the upper part of Ciujung River, which is currently under development, will function to supply clean water in Serang and Jabotabek by using the Karian-Tanjung-Serpong canal, irrigation water for Ciujung, and as Ciujung's flood controller for areas between Rangkasbitung and Pamarayan Weir. The effective carrying capacity is 219 m³ and it is able to generate 5.2 MW electricity.

- The Cidurian River disgorges at the Mount Halimun-Salak National Park. The river is 181,50 km in length and its watersheds cover an area of 928 km². It has 139 tributaries that range from the first order to the fifth order.

Flood often occurs because of broken down dyke, such as the dyke in Kresek Sub-regency, which flooded hundreds of houses including the Jayanti Sub-regency and Tigaraksa Sub-regency.

In addition, the Cidurian River also experienced pollution caused by liquid waste from ten industries located along the river.

1.5. Hydrology

Table 2: Rainfall Recording Stations

No	Name of Watershed	Total
1	Ciujung	23
2	Cidurian	9
3	Cilemer	3
4	Cipasauran	1
5	Cibeber	1
6	Cibanten	1
7	Cimoyan	1
8	Cisata	3
9	Cibama	1
10	Cibungur	1
11	Ciberang	1
12	Cimoyan	1
13	Ciliman	2
14	Cibama	1
15	Citeneng	1
Total		**50**

In general, the average annual rainfall ranges from 2,000 mm for the northern part, which areas are relatively flat, to 4,000 m for the southern part, which areas are mountainous. Rainy season occurs from October to April, while the other months are the dry season. The highest rainfall occurs in January to February, while the lowest in July. In the work area of BBWS 3 Ci, there are 50 Rainfall Recording Stations spread in 15 watersheds as shown in Table 2.

The Cidanau Watershed functions as a water catchment area, especially in the area of Banten Province. According to Munibah (2008), the erosion rate of Cidanau Watershed is 149.7 tons/hectares/year.

The almost deforested land along the river basin, massive erosion during rain, silting up of rivers due to sedimentation, and dense settlements in riverbanks are the factors that cause flooding in the Ciujung Watershed, Banten. The sedimentation rate of Ciujung River is 2.5 mm per year. The watershed's categorized as poorly conditioned watershed as the sedimentation rate is more than 2 mm per year. The Ciujung Watershed also has a low Permanent Land Conver Index, which is 11 percent. The index is considered poor if it is smaller than 20 percent.

The river regime coefficient, which compares the maximum and minimum discharge of the Ciujung Watershed, is 189, far greater than 80.

The river water discharge's coefficient of variance (CV), which compares the existing discharge and the average discharge, shows a value of 48. This is categorized as poor as it is greater than 30. "These four indicators confirmed that the Ciujung Watershed is already categorized as critical," said Sutopo.

The average annual rainfall ranges from 1,500 mm at the north coast's plains to 2,500 mm in the upstream. Temperatures range from 26°C to 30°C with humidity of 80% and wind speed ranging from 4 to 5 knots or 2.1 m/second.

1.6. Watersheds and Rivers

In accordance with the Presidential Decree Number 12 of 2012 regarding the Establishment of River Basins, the Cidanau-Ciujung-Cidurian River Basin, which consists of three sub-river basins, has 34 watersheds as shown in Table 3 below.

Among the three sub-river basins, the Ciujung Watershed is the first priority in the watershed management, while the Cidanau and Cidurian watersheds are the second priority.

The measurement of Cidanau river flow in Kp. Peusar Station during the period of January 2000 to December 2001 showed a monthly average discharge of 5,421 m^3/second.

The measurement of Ciujung river flow in Rangkasbitung Station during the period of 1992 to 1999 showed monthly average discharge ranging from 35.3 m^3/second (July) to 105,112 m^3/second (January).

Table 3: Watersheds in Cidanau-Ciujung-Cidurian River Basin

No	Code	Name of Watershed	No	Code	Name of Watershed
1	001	Cidanau	18	018	Cinangka
2	002	Cikalahi	19	019	Sumur
3	003	Runteun	20	020	Bojonagara
4	004	Cilegok	21	021	Candi
5	005	SetuLor	22	022	Cikebel
6	006	Kopomasjid	23	023	Cikubang
7	007	Kali Malang	24	024	Cikaidau
8	008	Cigobang	25	025	Cibako
9	009	Cicendo	26	026	Cigisik
10	010	Cigeblak	27	027	Cibanten
11	011	Cikebeletes	28	028	Cirangrang
12	012	Cibatu	29	029	Ciwaku
13	013	Cinangsi	30	030	Cibunar
14	014	Cisalak	31	031	Ciujung
15	015	Cipetey	32	032	Cidurian
16	016	Caringin	33	033	Cirumpak
17	017	Ciraginggang	34	034	Cipayeun

The measurement of Cidurian river flow in Kopomaja Station during the period of 1991 to 1999 showed monthly average discharge ranging from 5.899 m^3/second (August) to 25.499 m^3/second (January).

The current Safety Level Status of the Cidanau, Ciujung and Cidurian Rivers is Q5.

Development Realization: implemented improvement, rehabilitation and maintenance of flood embankments in Cidanau River, Ciujung River and Cidurian River according to the target set in the Strategic Plan (Renstra) of 2010-2014 as well as the preparation of the Master Plan for Comprehensive Flood Management System in Cidanau River, Ciujung River and Cidurian River, which was a derivative of the Cidanau-Ciujung-Cidurian River Basin Water Resources Management Model in achieving the target of Safety Level Q5 for rural area and Q25 for urban area.

1.7. Budget Allocations of 2010, 2011 and 2012

The budget received from the 2011 Budget Implementation List (DIPA) showed a significant increased compared to the budget of 2010 and it was allocated evenly for all Divisions. The total budget of 2012 shows a slight increase in the Implementation Division and Others. However, there is a decrease in the Planning Division and Operation & Maintenance Division as shown in the following Table 4.

Table 4: Budget Implementation List (DIPA) of BBWS Cidanau-Ciujung-Cidurian [xRp1.000,-]

DIPA	Planning Division	Implementation Division	Operation & Maintenance Division	Others	Total
2010	6,425,000	130,130,000	6,340,000	6,491,824	149,386,824
2011	9,914,216	223,360,205	13,147,281	8,841,023	255,262,725
2012	8,250,000	226,707,189	10,830,765	9,995,735	255,783,689

1.8. Issues

a) Critical Land

The conditions of lands in the Cidanau-Ciujung-Cidurian River Basin are categorized as very critical, critical, rather critical and potentially critical and these lands extend to 340.098 hectares, as shown in the following Table 5.

Table 5: Categories and Areas of Critical Lands

No	Category	Area (Ha)
1	Very Critical	1,024
2	Critical	25,124
3	Rather Critical	94,101
4	Potentially Critical	219,849
	Total	**340,098**

The critical lands occurred due to the conversion of lands into settlements, offices, industries, cassava plantations and oil palm plantations, as well as improper land cultivation as shown in Figure 2 below.

Figure 2: Land Conversion and Improper Cultivation

These critical lands led to increased erosion rate, such as the case in Cidanau where the erosion rate is 149,7 tons/ha/year (Munibah), which then resulted in the silting up of Danau Swamp.

The spread of the critical lands can be seen in the following Figure 3.

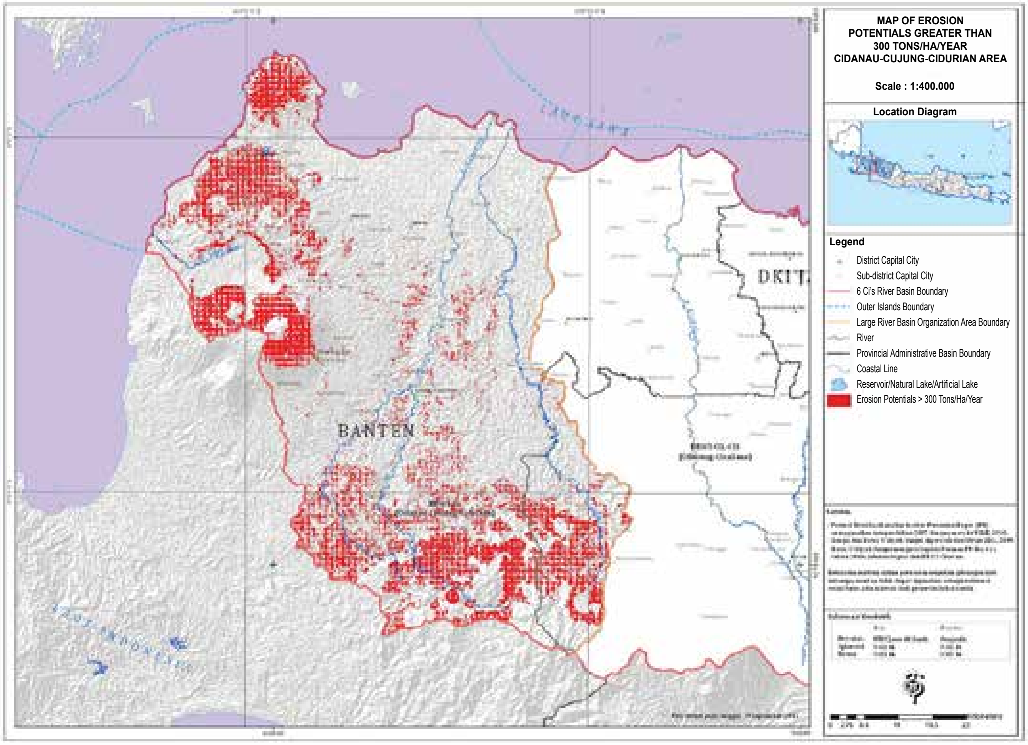


Figure 3: Erosion Potential Map

b) Flood and Drought

Flooding occurs due to the overflowing of several rivers. Among the frequently overflowing rivers are the Ciujung River, Cidurian River, Ciliman River, Cilemer River and Cibinangeun River. On 14-15 January 2012, floods were experienced by at least 10,340 families, including on the Jakarta-MerakToll Road, which was flooded for 3 km long, with depth reaching 1.50 M.

Table 6: Flood Inundations on 14-15 January 2012

No	River	Settlement (family)	Industry	Farm (Ha)
1	Ciujung	4,364	20 factories	-
2	Cidurian	1,950	2 factories	1,100
3	Ciliman	1,312		853
4	Cilemer	1,757		876
5	Cibinuangeun	957		774

For rivers that empty into the Java Sea, flood inundations occurred along the river flow until the coastal area, and in Cidanau, inundations occurred due to the overflowing of Danau Swamp, which is located in the upstream area, shown in blue color in the following Figure 4.

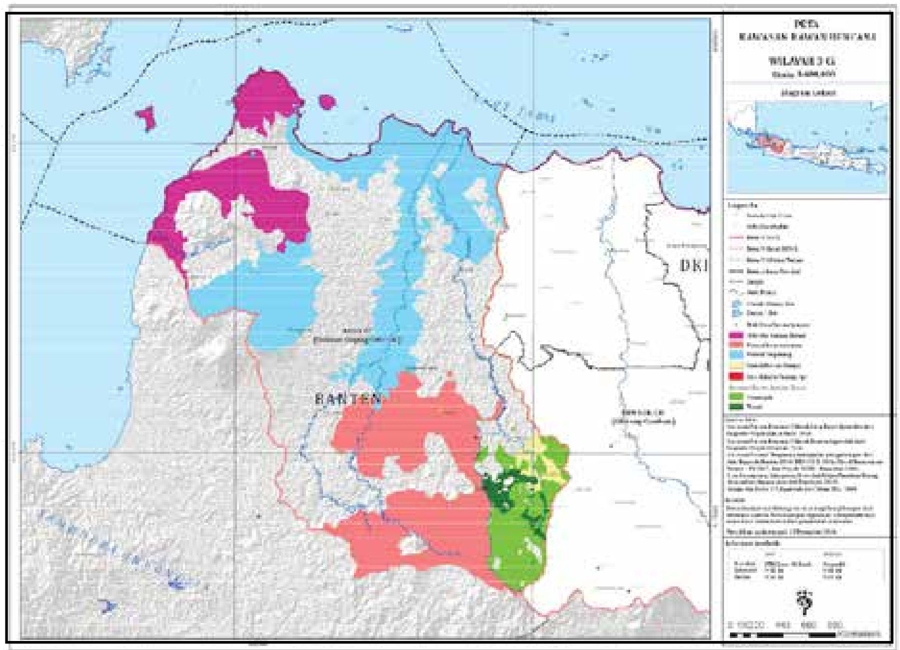


Figure 4: Flood-prone Locations

Heavy rains also cause frequent landslides in the upstream as shown in pink color in the figure above. This also results from the geological condition of the region which is very susceptible to land movement as shown in dark green and light green colors in the figure above.

The losses brought by this flooding were massive, because the floods did not only hit settlement and farming areas but also industrial areas and even the Jakarta-MerakToll Road. Even after the floods receded, the Toll Road was still congested because it was made as a place of evacuation by the residents whose houses were still flooded.

Figure 5: Floods in Residential Areas, Rural Areas, Urban Areas and on the Toll Road

One of the indicators of land damages is the high ratio of maximum discharge and minimum discharge. The maximum discharge in the rainy season leads to floods and the minimum discharge in the dry season leads to droughts.

Droughts cause reduced raw water supply for irrigation, industries and raw water requirements for the Regional Drinking Water Company (PDAM) and others in rural areas. The spread of locations that experience irrigation water supply shortage is shown in the following Figure 6.

Figure 6: Drought in Agricultural Land

c) Pollution

Pollutions that occur in rivers result from the disposal of industrial waste and domestic garbage as shown in the following Figure 7. These pollutions lead to water quality decline which then results in associated impacts on the water users, including agricultural plants which water is polluted.

Figure 7: Pollution by Industrial Waste and Garbage

d) Coastal Abrasion

Coastal abrasion occurs in several locations in 17 sub-regencies and 5 regencies in Banten Province. Other than being caused by waves, abrasion is also caused by human behavior, such as:

- Coastal sand excavation on the mainland. One exampleis what happened at the beach of Karangserang Village, Sukadiri, Tangerang Regency, where a six-foot-high mound of sand was piled on the beach. Some people carry the sand with a cart then lower it down on the side ofthe road to make it easier for the truck that transports it to other areas.

- Sand mining carried out by ships does not only suck up the sand, but also suck up mud that eventually damage the roots of mangrove plants. The impact of sand mining is now expanding into the coastal area of Banten Baywaters. Based on the data obtained, at present there are 30 thousand mangrove trees that died due to sandmining. This coastals and mining has now spread to Panjang Island.

Figure 8: Abrasion in Carita-Anyer and On the Roadside near Planned

Bojonegara Port

- The clearing of mangrove forest to be converted into fishpond area, such as the case in Garapan Ward, Bakau Tinggi Hamlet, Tanjung Pasir Village, Teluk Naga Sub-regency, Tangerang Regency. According to observation, coastal abrasion occurred for one kilometer long, and moreover, huge waves have swallowed 20-100 meters of the beach area in Garapan Ward and threatened 390 families.

The Search and Rescue (SAR) Team Post of the Regional Disaster Management Agency (BPBD) of Serang Regency on the shore of Bandulu Beach, Bandulu Village, Anyer Sub-regency almost collapsed. The post was damaged by the coastal abrasion that occurred in early 2012, as shown in the following Figure 9.

Figure 9: Abraded SAR Post

There is only one breakwater in the location that stretches for about 200 meters, while other larger, unprotected locations make the Karangserang Beach more prone to abrasion. Coastal protection plants such as mangrove no longer exist.

According to observation, coastal abrasion occurs for one kilometer long, and in addition, huge waves have swallowed 20-100 meters of the beach area in Garapan Ward.

In Garapan Ward, a 350 meter-long breakwater has been constructed for the first phase. Another breakwater with a length of 600 meter is currently under construction.

2. WATER RESOURCES MANAGEMENT

2.1. Water Resources Conservation

Efforts of conservation are carried out on critical lands in forest areas and especially on critical lands in the upstream area of dams or reservoirs planned to be constructed. In general, the recommendations for critical land conservation are stated in the following Figure 10.

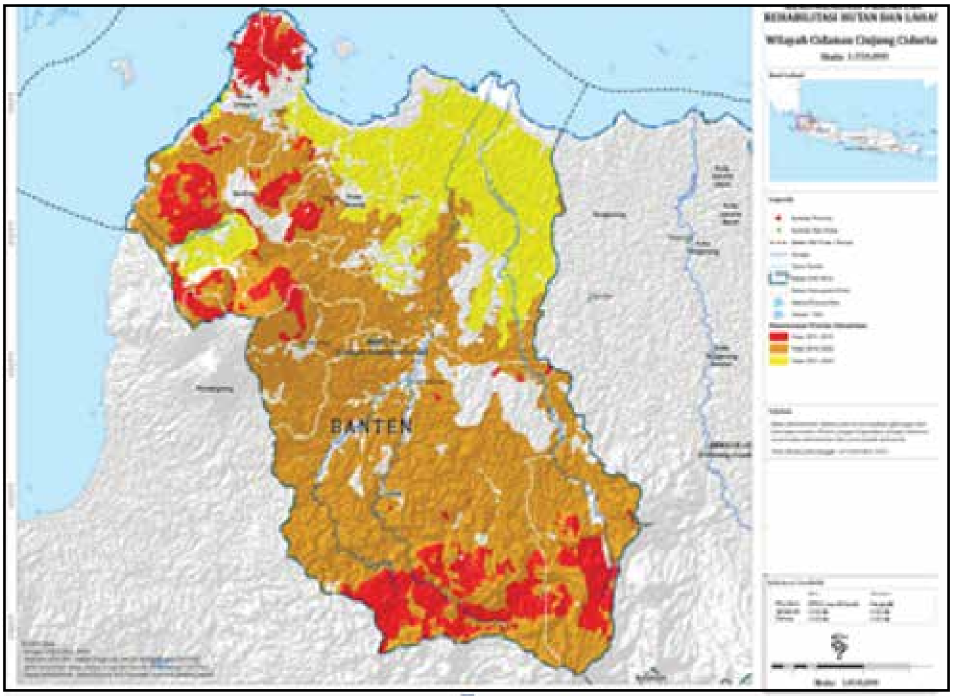


Figure 10: Recommendations for Critical Forest and Land Rehabilitation

The Objectives of Water Resources Conservation are:

a) Conservation on very critical and critical watersheds as well as upper area of reservoirs by:

- Implementing the recommendations provided by the Technical Plan for Forest and Land Rehabilitation – Watershed Management Agency, the Movement for Forest and Land Rehabilitation (Gerhan) and the National Movement for Water Safeguard Partnership (GNKPA),
- Striving for the Technical Plan for Forest and Land Rehabilitation Zonation Map to be included in the Regency/Municipal Regional Spatial Plan,
- Conserving watersheds with a principle of upstream-downstream cooperation, environmental services management,
- Conducting agricultural cultivation according to the conservation norms.

b) Protection of reservoirs, artificial lakes, swamps, springs & retention areas, as well as groundwater conservation by:

- Protecting water body, building water storages,
- Reducing groundwater abstraction permits (Serang-Tangerang Groundwater Basin), accompanied with replacement by providing surface raw water.

c) Realization of increased surface water quality by:

- Controlling the use of industrial Waste Water Treatment Plant (IPAL),
- Improving urban sanitation (dirty drainage & communal IPAL),
- Monitoring river water quality,
- Managing garbage.

d) Water saving through efficiency increase by:

- Applying SRI agriculture system,
- Conducting socialization on domestic and industrial water saving,
- Reducing drinking water pipe leakage.

e) Protection of critical coastal areas and beaches by:

- Protecting eroded beaches (32 locations),
- Protecting coastal cities against seawater level rise,
- Conserving mangrove forests.

Conservation of water resources in the work area of BBWS Cidanau-Ciujung-Cidurian is done by using an approach of physical construction of sediment (debris) retaining structures in erosion-prone rivers.

One of the physical/construction efforts in overcoming river erosion is by constructing the following structures:

- Cisela Consolidation Dam in Giri Raya Village, Cipanas Sub-regency, Lebak Regency,
- Cimaur I Consolidation Dam in Cipanas Sub-regency
- Ciherang I Consolidation Dam in KaduPecang Village, Cipanas Sub-regency.

ISSUE	Coastal Damage
MANAGEMENT	Coastal Protection, Mangrove Conservation, Coastal Embankment

Figure 11: Locations of Protection against Coastal Abrasion

2.2. Water Resources Utilization

a) Irrigation Water Provision

Provision of irrigation water in the Cidanau-Ciujung-Cidurian River Basin has developed since a long time ago and along with the development of industries and the requirements of residential areas and community settlements, in which some of them have been converted in their functions.

Irrigation water provision is also done through the physical construction of Consolidation Dams (sediment retaining dam) that also function to manage erosion and or to retain sediment. The consolidation dams that have been built in BBWS Cidanau-Ciujung-Cidurian include the physical facilities of Pamarayan Dam, etc.

The irrigation areas in the work area of BBWS Cidanau-Ciujung-Cidurian extend to 45,690 hectares in total, with 20,747 hectares of the total area spread in 13 locations and they are under the authority of the Central Government.

2.3. Water amounting to 15.99 m³/sec or 504.09 million m³/year is needed to meet all of the irrigation water requirements.

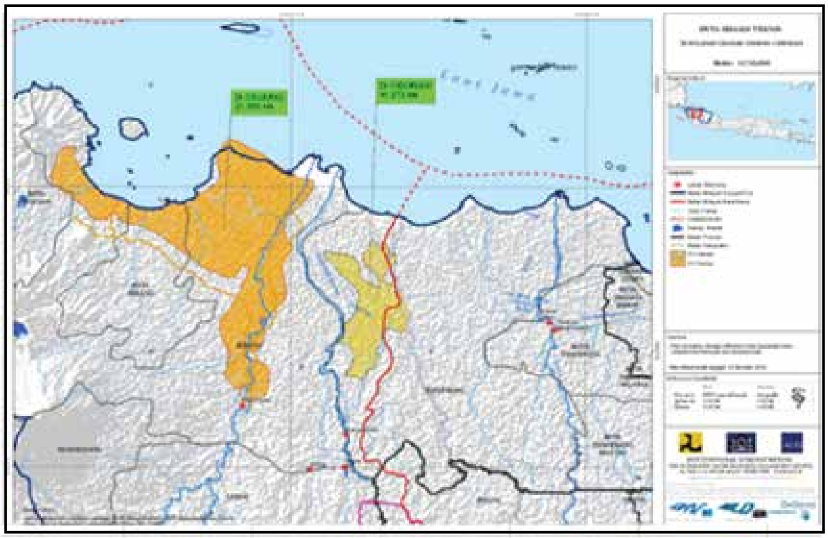


Figure 12: Irrigation Map

This irrigation water is also used for fishery irrigation related to fishponds. Based on their areas, fishponds are divided into the categories of intensive, semi-intensive, and traditional, as well as the cropping pattern/cropping season. In Cidanau-Ciujung-Cidurian River Basin, fishponds are spread in Serang Regency and Tangerang Regency. The total areas of fishponds (based on the regencies included in the northern part of Banten Province) extend to 10,243 hectares.

Figure 13: Pamarayan Dam

b) Raw Water Provision

Provision of raw water is done primarily for meeting the requirements of industries and the Regional Drinking Water Company (PDAM) in serving community needs especially in Serang Municipality. Raw water provision is carried out by:

- Constructing Cisirih Rubber Weir
- Constructing the retention basin of Cisirih Rubber Weir,
- Constructing Ciberung Rubber Weir
- Constructing Cibanten Rubber Weir (Phase I)
- Constructing Cibanten Rubber Weir (Phase II)
- Constructing rural raw water reservoir in Garung Village, Anyer Sub-regency, Serang Regency
- Constructing Krenceng Reservoir

Water requirements for households, urban areas and industries are around 9,508 m³/second.

2.3. Water's Damaging Ability Control

Damages caused by flooding continue to increase each year because the value of investment on flood-prone areas continues to increase and losses therefore become greater on the same areas of inundation. The value of damage is obtained by multiplying the level of vulnerability by the number of occurrences. Flooding in an uninhabited area will not cause any losses. When there are people living in the area, and they are not ready for (vulnerable to) flooding, then there will be losses resulted from the flooding.

The control of water's damaging ability in BBWS Cidanau-Ciujung-Cidurian is carried out as part of the efforts to overcome the issue of flooding with the following approach:

1) Flood Risk Management Concept and
2) Objectives of Water's Damaging Ability Control

Objectives of Water's Damaging Ability Control

a) Reduced frequency of flood occurrences

- Conducting watershed conservation
- Reducing clearing of floodplains, retention areas and riverbanks
- Increasing river maintenance and normalization
- Improving flood embankments

b) Reduced impact of losses due to floods

- Applying the regulation on constructions that are resistant to flood
- Conducting socialization on the preparedness against flood

c) Managed danger of seawater flooding

- Increasing the protection in Old Banten Municipality
- Improving sea embankments in coastal cities

d) Reduced losses due to droughts and landslides

- Conducting efficiency on water requirements and cropping pattern planning
- Conducting the mapping and socialization of landslide-prone areas

The constructions of physical infrastructures for water's damaging ability control that have been carried out in the work area of BBWS Cidanau-Ciujung-Cidurian include:

- Riverbank reinforcement of Cimaur River in Lebak Regency
- Construction of Ragas Masigit embankment in Ciujung River, Serang Regency
- Construction of Cibodasembankment in Ciujung River, Serang Regency
- Normalization of Cibenda River in Pandeglang Regency.
- Riverbank reinforcement of Cikalumpang River in Serang Regency
- Riverbank reinforcement of Cidurian River in Serang Regency
- Construction of Cikambuy River and Lempuyang River embankments
- Improvement/completion of embankment and valve in Cidurian River in Serang Regency
- Improvement/completion of embankment in Cigudeg Village, Cidurian River, Bogor Regency

2.4. Water Resources Information System

The information system implemented in BBWS Cidanau-Ciujung-Cidurian is primarily for providing information on rain and flood possibility that needs to be informed immediately to the people as well as flood control and management operations.

The objectives of the water resources information system include:

- Realization of a complete and reliable water resources database
- Availability of human resources and the improvement of their capacities
- Rationalization and procurement of adequate equipment

- Water resources data that are coordinated among related agencies and easy to access by the community
- Funding commitment for an integrated water resources information system (SISDA) by the relevant agencies

In addition, several data such as data on water discharge and water level resulted from observations in several locations in the main rivers can also be obtained from the BBWS Cidanau-Ciujung-Cidurian website.

2.5. Community Empowerment and Participation

The Objectives of Community and Private Sector Empowermentand Participation Improvement are:

1) To improve institutions

- Increasing the capacities of work units and their cooperation
- Meeting the needs of employees and increasing their capacities
- Creating an integrated program and budget preparation among agencies
- Collecting water resources management services
- Establishing a Public Service Agency for Water Resources Management

2) To increase community awareness:

- Conducting socialization on domestic and urban water saving
- Conducting socialization on irrigation water saving
- Conducting socialization on industrial water saving through the 3R system

3) To increase preparedness against flood

4) To increase the awareness on garbage management and environmental sanitation

5) To implement and develop CSR for water resources conservation and environment

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. General

In implementing water resources management in the future, the National Strategic Issues have been declared, which include the following:

- Millennium Development Goals (MDGs) Program
- Food Sustainability
- Energy Availability
- Global Climate Change
- Good Governance in Water Resources Management
- Implementation of Spatial Planning in Water Resources Management

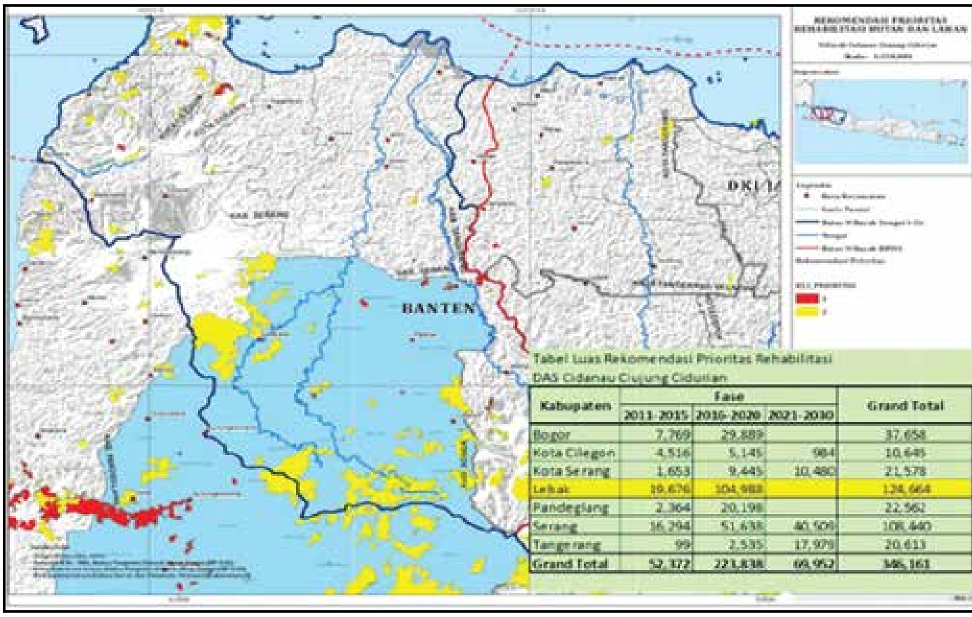
3.2. Comprehensive Management

The comprehensive management referred to here is a management that takes into consideration the water resources management pillars in order to realize the national strategic issues.

The physical construction of strategic water resource infrastructures in BBWS Cidanau-Ciujung-Cidurian is by building multi-function dams that provide great benefits for meeting the community needs.

a) Conservation

Conservation will be carried out according to the Recommendations from the Watershed Management Agency as shown in the Forest and Land Rehabilitation Map in Figure 14 below. The figure shows the Forest and Land Rehabilitation Program until 2030 which covers an area of 346,161 hectares.



Kabupaten	Fase			Grand Total
	2011-2015	2016-2020	2021-2030	
Bogor	7,769	29,889		37,658
Kota Cilegon	4,516	5,145	984	10,645
Kota Serang	1,653	9,445	10,480	21,578
Lebak	19,676	104,988		124,664
Pandeglang	2,364	20,198		22,562
Serang	16,294	51,638	40,509	108,440
Tangerang	99	2,535	17,979	20,613
Grand Total	52,372	223,838	69,952	346,161

Figure 14: Locations of Forest and Land Rehabilitation Program

b) Water Resources Utilization

There are 7 potential locations for dam construction, including the Karian Dam which is currently under construction, as shown in the following Figure 15.

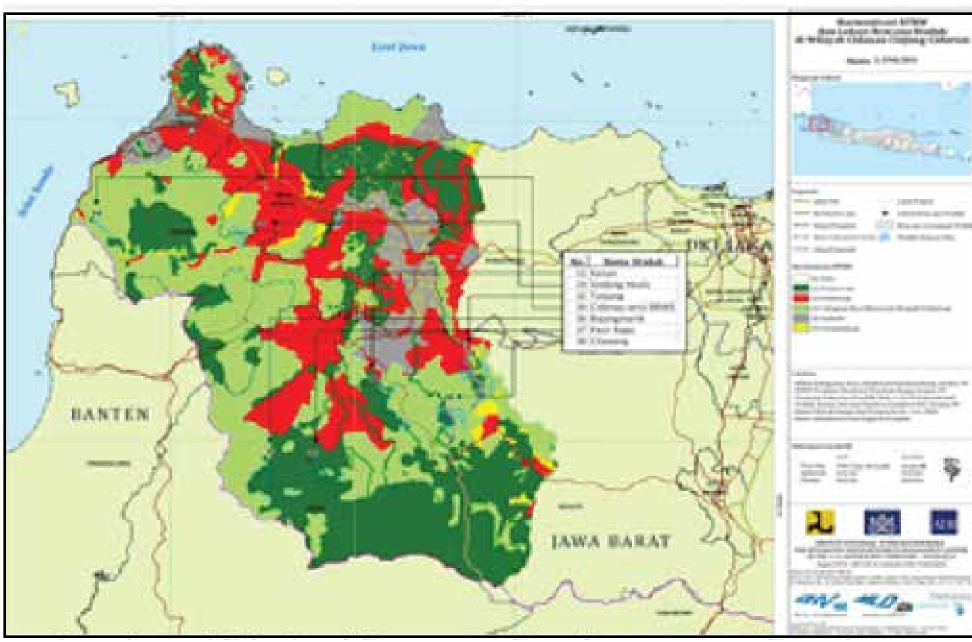


Figure 15:Locations of Dam Construction Plans

The dams planned to be constructed include:

- Cidanau Dam, which will be used for supplying raw water for Cilegon. Cidanau Dam is built by using the Dano Swamp and Cidanau River as the water sources.

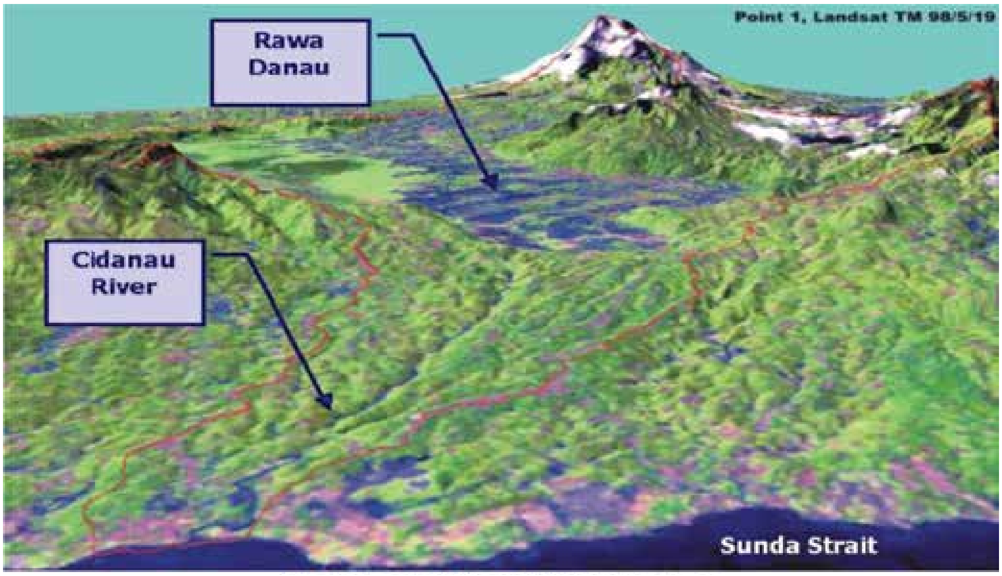


Figure 16: Cidanau Watershed

- Krenceng Dam, which serves as a raw water storage that is used when there is a problem with the Cidanau Pump House I or when the Cidanau River discharge is below the requirements.

  The effective capacity is 2.5 million m³ and the dam has an area extending to 104 hectares. The capacity will be increased to 4.5 million m³ by way of dredging.

- Sindang Heula Dam in Cibanten River

- Karian Dam in Ciherang River, which is a tributary of the Ciujung River. The Karian Dam is able to supply raw water for urban and industrial areas in Tangerang Municipality, Banten, in an amount of 9.1 m³/second, additional raw water for urban and industrial areas in Serang Municipality, Cilegon, and additional irrigation water for the 23-hectare Ciujung Irrigation Area.

3.3. Spatial Planning

Spatial planning is an important matter that will greatly support the realization of water resources management as well as the implementation of Law Number 26 of 2007 on Spatial Planning and related provisions that include:

- Zonation (infiltration area, retention area, etc)
- Recommendation of Sustainable Agricultural Land (technical irrigation)
- Inclusion of socialization on construction supervision (Building Construction Permit/IMB) in the Regional Spatial Plan

This spatial planning issue encountered the conflict of interest on the need of irrigation areas and settlement areas, in which according to the population growth, the need for settlement areas continues to increase, and this led to some irrigation lands being converted into residential, settlement, industrial areas etc.

3.4. Implementation Strategy

The strategy for implementing a comprehensive management in the work area of BBWS Cidanau-Ciujung-Cidurian uses a hydrology and authority-based approach in establishing policies and therefore requires coordination between the Central, Provincial and Regency/Municipal Governments. The measures taken are as follows:

- Conducting the inventorying of hydrological data in a comprehensive and continuous manner for various requirements as part of water resources management in BBWS Cidanau-Ciujung-Cidurian.

- Conducting monitoring and creating a water resources and flood information system, conducting more comprehensive evaluation and studies for future water resources management with regard to climate changes.

- Preparing the Comprehensive Management Plan of BBWS Cidanau-Ciujung-Cidurian by conducting conservation, water resources utilization, water's damaging ability control, debris flow flood control, coastal protection against abrasion, water resources information system implementation, as well as community empowerment, monitoring and involvement.