Supporting Report H

SABO MANAGEMENT

The Republic of Indonesia

THE PROJECT
FOR
ASSESSING AND INTEGRATING CLIMATE CHANGE IMPACTS INTO THE WATER RESOURCES MANAGEMENT PLANS FOR BRANTAS AND MUSI RIVER BASINS
(WATER RESOURCES MANAGEMENT PLAN)

FINAL REPORT

Supporting Report H : SABO MANAGEMENT (Brantas River Basin)

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CHAPTER H1 ABOUT SEDIMENT DISCHARGE BY CLIMATE CHANGE INFLUENCE IN THE BRANTAS RIVER BASIN

H1.1 Sediment Inflow and Surface Erosion Rate

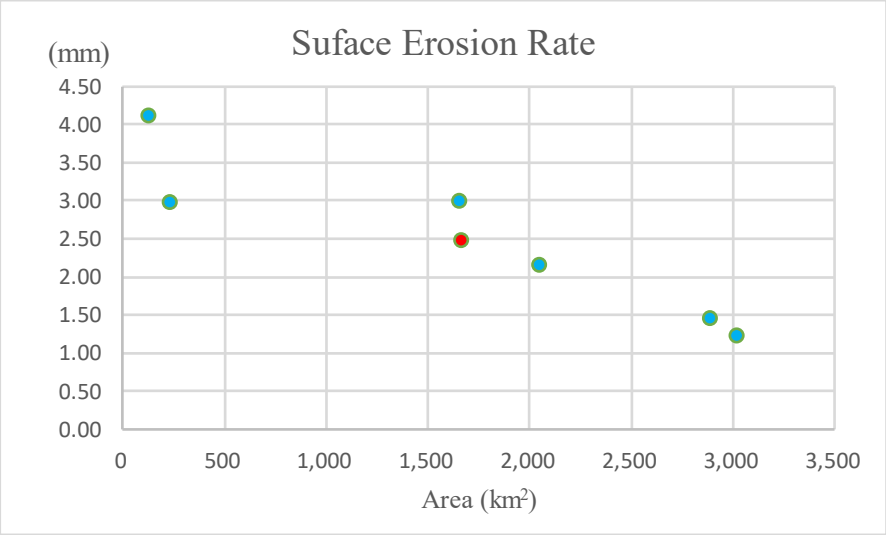
Table H1.1.1 shows the sediment inflow, the specific sediment inflow and the surface erosion rate estimated based on the past. Figure H1.1.1 shows the relationship between the catchment area and the surface erosion rate.

Table H1.1.1 Estimated Sediment Inflow at the Respective Dams

Dam Name	Area (km^2)	Estimated Sediment Inflow* (10^6 m^3/year)	Specific Discharge of Sediment* (m^3/km^2/year)	Surface Erosion Rate (mm/year)	Interval		
Sengguruh	1,659.0	4.950	2,984	2.98	1,988	-	2,012
Sutami	2,050.0	4.390	2,141	2.14	1,989	-	2,012
Wlingi	2,890.0	4.170	1,443	1.44	1,995	-	2,012
Lodoyo	3,017.0	3.710	1,230	1.23	1,996	-	2,012
Wonorejo	126.3	0.520	4,117	4.12	2,004	-	2,012
Selorejo	236.0	0.700	2,966	2.97	1,970	-	2,011
Mean (1-6)	1,663.1	3.073	2,480	2.48			

*: Average

Source: JICA Project Team 2



Source: JICA Project Team 2

Figure H1.1.1 Surface Erosion Rate by Catchment Area

From these results, the trend of sediment discharge is presumed as follows;

1) The average surface erosion rate is 2.48mm/year. On the other hand, that of the upstream area of Senggurh Dam called the upper Brantas shows 2.98mm which is a relatively large scale in comparison with the other dams.

2) The surface erosion rate of Wonorejo dam's catchment in Mt. Wilis area which is hardly affected by Mt. Kelud is 4.12mm. This value is thought to be a high value considering the basin condition whose development is not so remarkable.

3) The surface erosion rate of the Wlingi and Lodoyo dams is a rate which the sediment is trapped by the Sutami dam. Also, the Wlingi dam is not influenced by Mt. Kelud due to the bypass channel.

4) The basin of the Selorejo dam which is located at the north-east side of Mt. Kelud has been developed widely. The sediment inflow into the dam is presumed to be a lot, but there is no enough data about the actual condition. An annual erosion rate 2.97mm is thought to be relatively high. Therefore, an additional survey for check is required.

5) It is thought that the value of 2.98mm, which is an erosion rate of the upper Brantas, means the following two points. The first means that there is a lot of surface erosion from the cultivated lands, slope failure and bank erosion in comparison with the other catchment areas. The second means that the erosion rate is basically the same, but there is the other factor.

6) According to this survey, there are few slope failures and little bank erosion. It is difficult to assume that the extensive fields (carrot, potatoes, cabbage and etc.) of the upper Brantas take the greater part of 2.98mm.

7) On the other hand, the muddy water is observed in spite of the dry season in the Aran-aran and the Lesti rivers whose top sections are located at the west side of Mt. Semeru. Probably, this condition is thought to be the main factor. The additional survey for check is required.

H1.2 About Amount of the rainfall of Present Climate and Future Climate

The amount of the rainfall of the present climate and the future climate is calculated by three scenarios, i.e. Lower, Medium and High Scenario (Reference material 1).

Table H1.2.1 shows the total amount of the rainfall by the scenario of the present climate (Sum 2000: 1981.1.1 - 2000.12.31) and the future climate (Sum 2050: 2046.1.1 - 2065.12.31).

According to Table H1.2.1, The future total amount of the rainfall of the Brantas River basin (Total W/S) is 2 - 1 % less compared to the present climate in Lower and Medium Scenario. Conversely, in High Scenario, the variation width shows the 2% increase. But in scenario average, there is almost no change.

On the other hand, the total amount of the rainfall of the target 7 dams (Senggurh, Sutami Wlingi, Lodoyo, Selorejo, Wonolejo and Bunin Dams) is as follows. The future total amount of the rainfall in Lower and Medium Scenario is 5 - 1% less compared to the present climate. But in High Scenario, there is almost no change. However, the variation width shows the 2% decrease in scenario average. On the whole, the future total amount of the rainfall is presumed to be almost the same as the present climate.

Table H1.2.1 Total Amount of the Rainfall in the Present and Future

Scenario		T.A of Rainfall (mm)	
		Total W/S	Dam W/S
High	Sum2000	6,051,766	1,662,558
	Sum2050	6,184,371	1,656,847
	2050/2000	1.02	1.00
Medium	Sum2000	5,887,619	1,692,505
	Sum2050	5,850,764	1,675,907
	2050/2000	0.99	0.99
Low	Sum2000	6,000,900	1,690,499
	Sum2050	5,891,823	1,600,504
	2050/2000	0.98	0.95
Ave	Sum2000	5,980,095	1,681,854
	Sum2050	5,975,653	1,644,419
	2050/2000	1.00	0.98

T.A : Total Amount, W/S: Watershed

Source: JICA Project Team 2

H 1.3 About the Sediment Discharge

H 1.3.1 Rainfall and Runoff Factor concerning Soil Erosion

The sediment discharge to the dams is presumed as follows.

As mentioned above, the specific discharge of sediment and the surface erosion ratio are 2,752 (m^3/km^2/year) and 2.75 (mm/year) respectively in the present climate. The sediment discharge in the future climate is studied by the following method.

The change of the sediment discharge in the future climate is studied by the following formula (USLE: Universal Soil Loss Equation) which is applied about surface soil erosion.

USLE is shown as follows;

$A=R \cdot K \cdot LS \cdot P \cdot C$ (t/ha/year)

where,

A：amount of average annual soil loss

R：rainfall and runoff factor

K：soil erodibility factor

LS：slope length-gradient factor

P：support practice factor

C：crop/vegetation and management factor

R is represented as follows;

$R = (E \times I_{60}) / 100$

E is defined to be the amount of the rainfall energy of a series of rainfall.

$E = (210 + 89\mathrm{Log}I) \times r$

I：maximum hourly rainfall in a series of rainfall (cm/hour)

r：total amount of a continuous rainfall (cm)

Also, a continuous rainfall is defined to be the rainfall which no rainfall continues more than 6 hours from the end of the rainfall.

On the other hand, the maximum hourly rainfall in a series of rainfall (I) in the Brantas basin is already calculated as follows (Reference material 2);

- Upper Brantas : 38.1% of the daily rainfall
- South Mt.Kelud : 47.2% of the daily rainfall
- South West Brantas : 49.8% of the daily rainfall
- North Brantas : 52.0% of the daily rainfall

Where, "I" was set 50% of a daily rainfall to avoid complexity of calculation and to take a general trend. "R" can calculate using the daily rainfall of the present climate (the calculation term: 01.Jan.1981 – 31.Dec.2000) and that of the future climate (the calculation term: 01.Jan. 2046 – 31. Dec. 2065). Also, the other factors except the rainfall factor in the future climate are supposed to be the same as the present ones. The results are as follows.

Table H1.3.1 shows the result of "R", i.e., the ratio (2050/2000) about the whole basin of Brantas (136 model basins) and the basins of seven dams.

"R" (rainfall and runoff factor) ratio in the Brantas Basin is expected an average increase of 21%, the target dam basins is expected an average increase of 15%. This increase is assumed to be caused by increase of hourly rainfall under the future climate.

Table H1.3.2 and Table H1.3.3 show the detail results.

Table H1.3.1 Ratio of "R" about Brantas and Dam Basins

Scenario	Whole Basin	Dam Basin
High	1.33	1.25
Medium	1.12	1.12
Low	1.19	1.09
Average	1.21	1.15

Source: JICA Project Team 2

Table H1.3.2 The Rainfall and Runoff Ratio of the Brantas Basin

Divided basin	ws280	ws278	ws277	ws274	ws272	ws270	ws268	ws266	ws264	ws262	ws260	ws258	ws254	ws252
High (2050/2000)	1.31	1.27	1.39	1.37	1.38	1.40	1.40	1.43	1.42	1.40	1.40	1.39	1.43	1.38
Medium (2050/2000)	1.11	1.12	1.11	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.11
Lower (2050/2000)	1.29	1.08	1.21	1.27	1.31	1.31	1.31	1.30	1.29	1.30	1.31	1.31	1.31	1.29
Ave	1.23	1.16	1.24	1.25	1.27	1.27	1.27	1.28	1.28	1.27	1.27	1.27	1.29	1.26
Divided basin	ws250	ws248	ws246	ws244	ws242	ws240	ws238	ws236	ws234	ws232	ws230	ws228	ws224	ws222
High (2050/2000)	1.34	1.43	1.43	1.45	1.43	1.43	1.44	1.32	1.39	1.33	1.30	1.32	1.33	1.33
Medium (2050/2000)	1.11	1.12	1.12	1.12	1.12	1.12	1.13	1.11	1.12	1.11	1.11	1.12	1.12	1.12
Lower (2050/2000)	1.27	1.30	1.27	1.27	1.29	1.30	1.27	1.25	1.24	1.23	1.23	1.23	1.23	1.22
Ave	1.24	1.28	1.27	1.28	1.28	1.28	1.28	1.22	1.25	1.23	1.21	1.22	1.22	1.22
Divided basin	ws220	ws218	ws216	ws214	ws212	ws210	ws208	ws206	ws204	ws202	ws200	ws198	ws196	ws194
High (2050/2000)	1.31	1.27	1.26	1.29	1.26	1.26	1.26	1.25	1.25	1.26	1.24	1.22	1.24	1.24
Medium (2050/2000)	1.12	1.12	1.14	1.17	1.14	1.14	1.14	1.13	1.12	1.14	1.13	1.12	1.12	1.12
Lower (2050/2000)	1.22	1.23	1.09	1.10	1.05	1.06	1.05	1.07	1.08	1.05	1.05	1.04	1.07	1.07
Ave	1.22	1.20	1.16	1.19	1.15	1.15	1.15	1.15	1.15	1.15	1.14	1.13	1.14	1.14
Divided basin	ws192	ws190	ws188	ws186	ws184	ws182	ws180	ws178	ws176	ws174	ws172	ws170	ws168	ws166
High (2050/2000)	1.22	1.25	1.28	1.25	1.23	1.31	1.22	1.22	1.23	1.23	1.23	1.21	1.23	1.21
Medium (2050/2000)	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.13	1.13	1.11	1.13	1.10	1.12	1.10
Lower (2050/2000)	1.05	1.10	1.20	1.14	1.07	1.29	1.05	1.04	1.04	1.14	1.06	1.10	1.05	1.08
Ave	1.13	1.16	1.20	1.17	1.14	1.24	1.13	1.13	1.13	1.16	1.14	1.14	1.13	1.13
Divided basin	ws164	ws160	ws162	ws156	ws154	ws152	ws281	ws279	ws150	ws148	ws146	ws144	ws142	ws140
High (2050/2000)	1.25	1.21	1.25	1.22	1.25	1.22	1.24	1.24	1.24	1.24	1.23	1.26	1.26	1.26
Medium (2050/2000)	1.13	1.10	1.13	1.10	1.13	1.11	1.13	1.13	1.13	1.12	1.12	1.12	1.13	1.12
Lower (2050/2000)	1.06	1.10	1.05	1.23	1.05	1.13	1.06	1.07	1.08	1.13	1.18	1.18	1.16	1.19
Ave	1.15	1.13	1.14	1.18	1.14	1.15	1.14	1.15	1.15	1.16	1.18	1.19	1.18	1.19
Divided basin	ws138	ws136	ws134	ws132	ws130	ws128	ws126	ws124	ws122	ws120	ws116	ws114	ws110	ws108
High (2050/2000)	1.25	1.26	1.28	1.25	1.26	1.27	1.25	1.25	1.26	1.27	1.29	1.26	1.24	1.24
Medium (2050/2000)	1.12	1.12	1.12	1.12	1.13	1.12	1.12	1.13	1.13	1.14	1.12	1.14	1.12	1.12
Lower (2050/2000)	1.21	1.21	1.22	1.22	1.12	1.17	1.14	1.07	1.02	1.00	1.08	1.02	1.04	1.08
Ave	1.19	1.20	1.21	1.19	1.17	1.19	1.17	1.15	1.14	1.13	1.17	1.14	1.14	1.15
Divided basin	ws104	ws102	ws100	ws098	ws096	ws094	ws092	ws090	ws088	ws086	ws084	ws082	ws080	ws078
High (2050/2000)	1.24	1.25	1.27	1.25	1.36	1.25	1.26	1.30	1.31	1.37	1.36	1.39	1.36	1.39
Medium (2050/2000)	1.12	1.12	1.12	1.12	1.11	1.12	1.12	1.12	1.12	1.12	1.12	1.11	1.12	1.12
Lower (2050/2000)	1.04	1.11	1.12	1.18	1.21	1.18	1.22	1.22	1.22	1.22	1.21	1.22	1.21	1.22
Ave	1.13	1.16	1.17	1.19	1.23	1.19	1.20	1.21	1.22	1.24	1.23	1.24	1.23	1.24
Divided basin	ws076	ws074	ws072	ws070	ws068	ws066	ws064	ws060	ws058	ws054	ws052	ws050	ws048	ws046
High (2050/2000)	1.40	1.42	1.43	1.43	1.45	1.45	1.44	1.42	1.45	1.41	1.42	1.43	1.48	1.46
Medium (2050/2000)	1.12	1.12	1.12	1.12	1.12	1.13	1.13	1.11	1.12	1.11	1.11	1.11	1.12	1.12
Lower (2050/2000)	1.22	1.22	1.23	1.24	1.25	1.26	1.27	1.23	1.23	1.22	1.22	1.23	1.24	1.23
Ave	1.25	1.25	1.26	1.26	1.27	1.28	1.28	1.25	1.26	1.25	1.25	1.26	1.28	1.27
Divided basin	ws044	ws042	ws040	ws038	ws036	ws034	ws032	ws030	ws028	ws026	ws024	ws022	ws020	ws276
High (2050/2000)	1.48	1.44	1.44	1.46	1.47	1.48	1.48	1.48	1.47	1.45	1.47	1.46	1.45	1.45
Medium (2050/2000)	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.13	1.12	1.12	1.13	1.12
Lower (2050/2000)	1.24	1.22	1.23	1.23	1.24	1.24	1.24	1.24	1.26	1.27	1.26	1.26	1.27	1.28
Ave	1.28	1.26	1.26	1.27	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Divided basin	ws018	ws016	ws275	ws014	ws012	ws008	ws010	ws006	ws004	ws002	Ave			
High (2050/2000)	1.43	1.43	1.43	1.42	1.40	1.41	1.40	1.39	1.38	1.37	1.33			
Medium (2050/2000)	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.11	1.12	1.12	1.12			
Lower (2050/2000)	1.29	1.30	1.30	1.30	1.30	1.30	1.30	1.29	1.29	1.27	1.19			
Ave	1.28	1.28	1.28	1.28	1.28	1.28	1.27	1.27	1.26	1.25	1.21			

Source: JICA Project Team 2

Table H1.3.3 The Rainfall and Runoff Ratio of the Target Dam Basins

Divided basin	ws212	ws210	ws208	ws206	ws204	ws202	ws200	ws198	ws196	ws194	ws192	ws190	ws188	ws186	ws184	ws182	ws180	ws178
High (2050/2000)	1.26	1.26	1.26	1.25	1.25	1.26	1.24	1.22	1.24	1.24	1.22	1.25	1.28	1.25	1.23	1.31	1.22	1.22
Medium (2050/2000)	1.14	1.14	1.14	1.13	1.12	1.14	1.13	1.12	1.12	1.12	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.13
Lower (2050/2000)	1.05	1.06	1.05	1.07	1.08	1.05	1.05	1.04	1.07	1.07	1.05	1.10	1.20	1.14	1.07	1.29	1.05	1.04
Ave	1.15	1.15	1.15	1.15	1.15	1.15	1.14	1.13	1.14	1.14	1.13	1.16	1.20	1.17	1.14	1.24	1.13	1.13
W/S	Sengguruh																	
Divided basin	ws176	ws174	ws172	ws170	ws168	ws166	ws164	ws160	ws162	ws156	ws214	ws154	ws152	ws281	ws279	ws280	ws278	ws040
High (2050/2000)	1.23	1.23	1.23	1.21	1.23	1.21	1.25	1.21	1.25	1.22	1.29	1.25	1.22	1.24	1.24	1.31	1.27	1.44
Medium (2050/2000)	1.13	1.11	1.13	1.10	1.12	1.10	1.13	1.10	1.13	1.10	1.17	1.13	1.11	1.13	1.13	1.11	1.12	1.12
Lower (2050/2000)	1.04	1.14	1.06	1.10	1.05	1.08	1.06	1.10	1.05	1.23	1.10	1.05	1.13	1.06	1.07	1.29	1.08	1.23
Ave	1.13	1.16	1.14	1.14	1.13	1.13	1.15	1.13	1.14	1.18	1.19	1.14	1.15	1.14	1.15	1.23	1.16	1.26
W/S	Sutami			Wlingi											Lodoyo	Selorejo	Wonorejo	Bening

Divided basin	Ave
High (2050/2000)	1.25
Medium (2050/2000)	1.12
Lower (2050/2000)	1.09
Ave	1.15

Source: JICA Project Team 2

H1.3.2 Sediment Discharge concerning Flood Discharge

First, average discharge of the present and the future climate is as shown in Table H1.3.4. According to Table H1.3.4, Medium scenario shows the least discharge in the case of the whole basin.

Table H1.3.4 Annual Discharge of the Present and the Future Climate

Classification			Whole year ($m^{3/}s$)	
			Whole Basin (ws002)	Dam Basin
Present[1)]	Average	a	365.60	57.17
Future[2)] Scenario	High (Ave)	b	382.78	54.92
	Medium (Ave)	c	304.47	49.56
	Low (Ave)	d	329.03	49.03
		b/a	1.05	0.96
		c/a	0.83	0.87
		d/a	0.90	0.86

1): 1991.1.1- 2010.12.31 2): 2046.1.1- 2065.12.31

Source: JICA Project Team 2

Next, the sediment yield of suspended load is studied as follows.

The sediment yield of suspended load is shown by the following formula.

$Qs=k*Qn$

Where,

Qs : Suspended sediment (ton/ hour)

Q : Discharge (m^3/s)

k, n: constant

In the Wlingi Dam basin, the sediment yield of suspended load had been surveyed before.

According to the result, the regression equation of Q-Qs is as shown in Table H1.3.5.

Table H1.3.5 Regression Equation of Q-Qs

River Name	Regression equation	k	n
Lekso	$Qs=k*Q^n$	0.06	2.60
Ganggangan		22	2.53
Jari		2	2.59
Putih		15	2.82

Source: Recommendation Report on Countermeasures against Sediment Inflow to Wlingi Reservoir (1990)

The ratio of the present climate to the future climate was calculated by the following formula.

$r = \sum Qsf/\sum Qsp = \sum k*Qnf/\sum k*Qnp = \sum Qnf/\sum Qnp$

where, the subscript “f” and “p” are as follows;

f : future climate

p : present climate

And, multiplier “k” and “n” were assumed as k=1, n= 2.50 respectively to take a rough trend.

The result of calculation about dam basin is as shown in Table H1.3.6 which shows annual average sediment yield and the ratio about the whole basin and the Dam basin.

Low and High scenario show an increasing trend, but Medium scenario shows a decreasing trend. An increasing rate which is shown in Table H1.3.6 is thought to be excessive. Table H1.3.7 shows the detail value about the whole basin and the Dam basin.

Table H1.3.6 Discharge Ratio of the Present Climate to the Future Climate

Classification			Whole Basin (ton/year)	Dam Basin (ton/year)
Present [1)]		a	2,545,715,841	411,974,047
Future [2)] Scenario	High	d	4,471,597,762	566,292,534
	Middle	c	2,579,112,510	378,325,636
	Low	b	5,254,133,380	715,453,937
		b/a	1.76	1.37
		c/a	1.01	0.92
		d/a	2.06	1.74

1): 1991.1.1- 2010.12.31 2): 2046.1.1- 2065.12.31

Source: JICA Project Team 2

Also, references materials are shown at the end of chapter.

Table H1.3.7 Detail of Discharge Ratio of the Present Climate to the Future Climate

Classification			Whole Basin (ws002)		Dam Basin								
			Sum (ton/20 years)	Ave (ton/year)	Sutami (ws172)	Sengruh (ws178)	Wlingi (ws281)	Lodoyo (ws279)	Selorejo (ws280)	Wonorejo (ws278)	Bunin (ws040)	Sum (ton/20 years)	Ave (ton/year)
Present [1)]		a	50,914,316,819	2,545,715,841	1,230,907,526	194,596,867	3,823,720,623	4,213,899,241	5,403,331	32,943	1,827,927	8,239,480,931	411,974,047
Future [2)] Scenario	High	b	105,082,667,594	5,254,133,380	1,477,592,716	228,802,163	5,261,666,998	5,824,910,791	7,066,635	24,750	3,379,336	11,325,850,673	566,292,534
	Middle	c	51,582,250,192	2,579,112,510	918,062,403	149,793,759	3,517,090,662	3,892,041,291	5,785,908	12,472	1,788,638	7,566,512,730	378,325,636
	Low	d/a	89,431,955,232	4,471,597,762	1,835,675,608	267,761,729	6,588,280,563	7,440,612,240	9,021,215	18,387	3,384,615	14,309,078,748	715,453,937
		b/a	2.06	2.06	1.49	1.38	1.72	1.77	1.67	0.56	1.85	1.74	1.74
		c/a	1.01	1.01	0.75	0.77	0.92	0.92	1.07	0.38	0.98	0.92	0.92
		d/a	1.76	1.76	1.20	1.18	1.38	1.38	1.31	0.75	1.85	1.37	1.37

Source: JICA Project Team 2

(Reference materials: 1)

About Weather Scenario

Item	Scenario Classification	Contents
Weather Scenario/GCM Name	Lower	Result of gfdl_cm2_0 model (Width of change in the future is large)
	Medium	Result of mpi_echam5 model (Width of change in the future is moderate)
	High	Result of ingv_echam4 model (Width of change in the future is small)

Source: JICA Study Team 2

(Reference materials: 2)

About hourly rainfall pattern in the Brantas Basin

Flooding of the Brantas River basin is thought to be caused by that of tributary. Therefore, it's better to use not daily flow, but hourly flow for analysis of flood. Rainfall characteristics of the Brantas River basin are as follows;

i) It rains not in the whole day, but in the daytime (9:00-17:00).

ii) Even though there is a continuous rainfall for two days, it does not rain in the night (18:00-8:00).

The number of rainfall data which is more than 100mm in the 24 hours is as shown in the table below (**Table H1.3.8)**

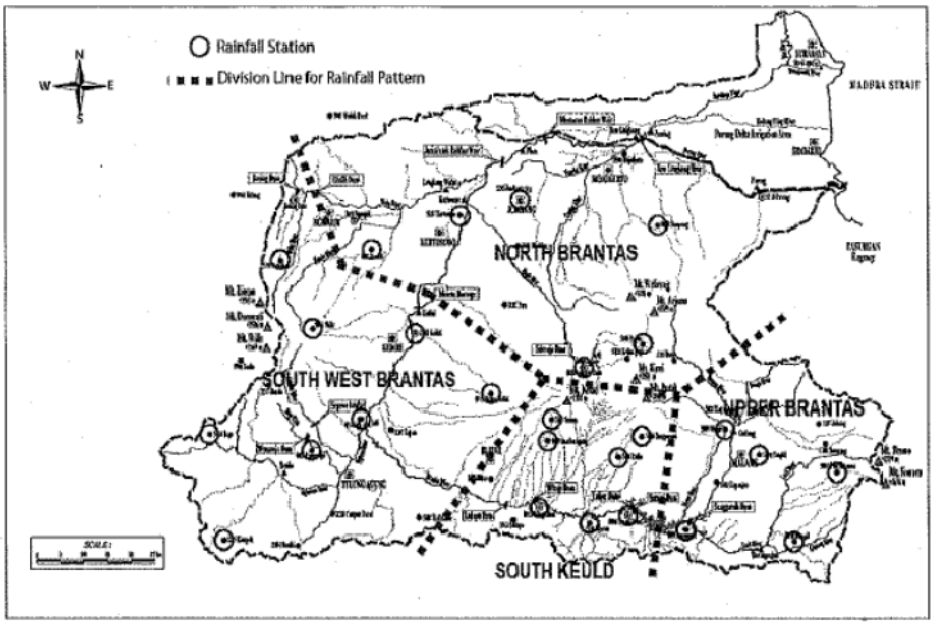
Table H1.3.8 Number of Data at Each Station

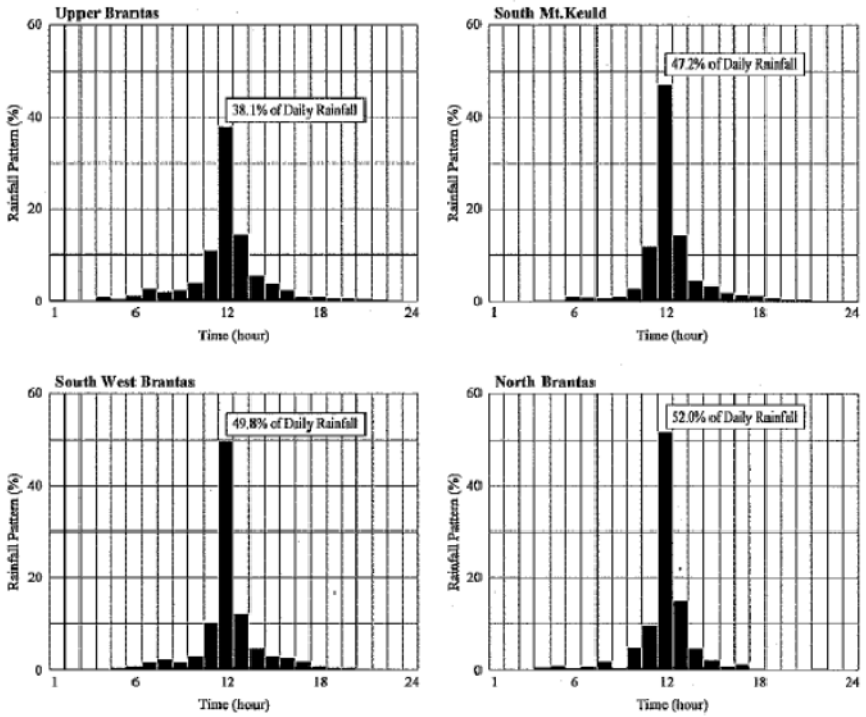
No.	Station Name	Nos of Data
Upper Brantas		**41**
1	Tangkil	5
2	Poncokusumo	2
3	Dampit	15
4	Sengguruh Dam	14
5	Wagir	5
South Mt Keuld		**222**
1	Sutami Dam	6
2	Birowo	15
3	Tunggorono	99
4	Sumberagung	14
5	Semen	22
6	Doko	17
7	Wlingi Dam	32
8	Wates Wlingi	17

No.	Station Name	Nos of Data
South West Brantas		**89**
1	Jeli	11
2	Wates Kediri	10
3	Wilis	53
4	Kediri	4
5	Wates Sawahan	1
6	Pagerwojo	5
7	Kampak	4
8	Tugu	1
North Brantas		**40**
1	Kertosono	4
2	Tampung	4
3	Pujon	2
4	Selorejo Dam	15
5	Berbek	15
	Total	**392**

Source: JICA Study Team 2

The rainfall pattern is studied about the Brantas River basin which is divided into four (Figure H1.3.1). As a result, each rainfall pattern is as shown in Figure H1.3.1 and in Table H1.3.9. Hourly rainfall is about 38 % to 52% of daily rainfall.





Source: JICA Study Team 2

Figure H1.3.1 Division of Basin and Rainfall Pattern

Table H1.3.9 Hourly Rainfall in Each Basin

Unit : % of Daily Rainfall

Time (hour)	Upper Brantas	South Mt.Keuld	South West Brantas	North Brantas
1	0.54	0.34	0.48	0.11
2	0.36	0.24	0.17	0.15
3	0.51	0.23	0.03	0.19
4	1.34	0.45	0.06	0.74
5	0.78	0.47	0.59	1.17
6	1.58	1.39	1.05	0.60
7	3.01	1.10	1.85	1.00
8	2.47	0.97	2.53	2.09
9	2.67	1.41	1.82	0.58
10	4.02	3.00	3.13	4.86
11	11.21	12.17	10.43	9.70
12	38.09	47.23	49.80	52.03
13	14.71	14.57	12.35	15.15
14	5.60	4.50	4.68	4.71
15	3.92	3.48	3.07	2.46
16	2.67	2.21	2.94	1.00
17	1.38	1.72	2.13	1.50
18	1.24	1.44	0.92	0.41
19	0.95	0.99	0.59	0.19
20	0.89	0.65	0.56	0.25
21	0.73	0.65	0.15	0.26
22	0.62	0.31	0.19	0.47
23	0.38	0.26	0.17	0.25
24	0.33	0.23	0.31	0.13

Source: JICA Study Team 2

CHAPTER H2 SABO MANAGEMENT

H2.1 Sediment Management Plan in the Brantas River Basin

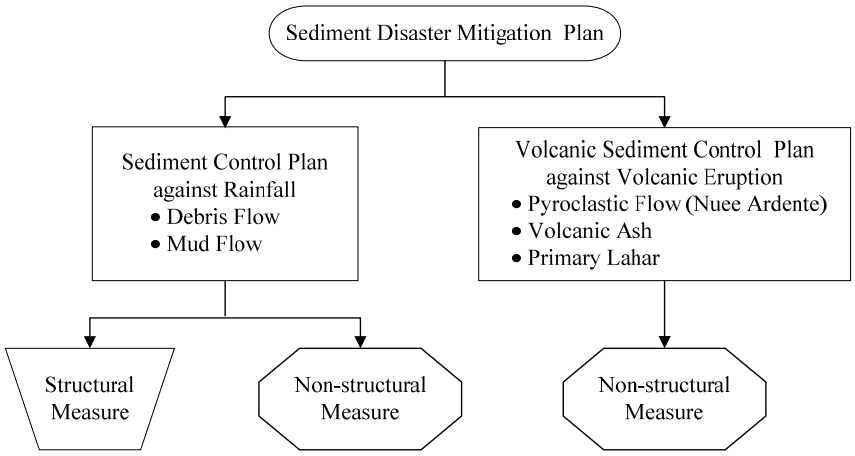
H2.1.1 Basic Policy

The sediment management plan in the Brantas River basin is compiled with a framework composed of the following two plans.

i) Sediment control plan in the Brantas River basin

ii) Mt. Kelud volcanic disaster mitigation plan

In these plans, the target against the plans is sediment disasters caused by the heavy rain after the eruption. Because, it is difficult to take measures directly against volcanic production such as volcanic ash, pyroclastic flow, etc. Planning policy is as shown in Figure H2.1.1. As shown in Figure H2.1.1, volcanic eruption is basically managed by the non-structural measure.



Source: JBIC Loan Report Supporting Report Annex No3

Figure H2.1.1 Planning Policy

H2.1.2 Necessity of Integrated Sediment Management

The report above describes that integrated sediment management, which includes “watershed conservation”, “Sabo plan”, “reservoir sediment management”, “control of sand mining”, etc. is important for sediment management from the most upper reaches of the Brantas River basin to the river mouth. Table H2.1.1 and Table H2.1.2 show the outline of integrated sediment management and Figure H2.1.2 shows that image.

Table H2.1.1 Proposed Comprehensive Basin-wide Sediment Management Plan

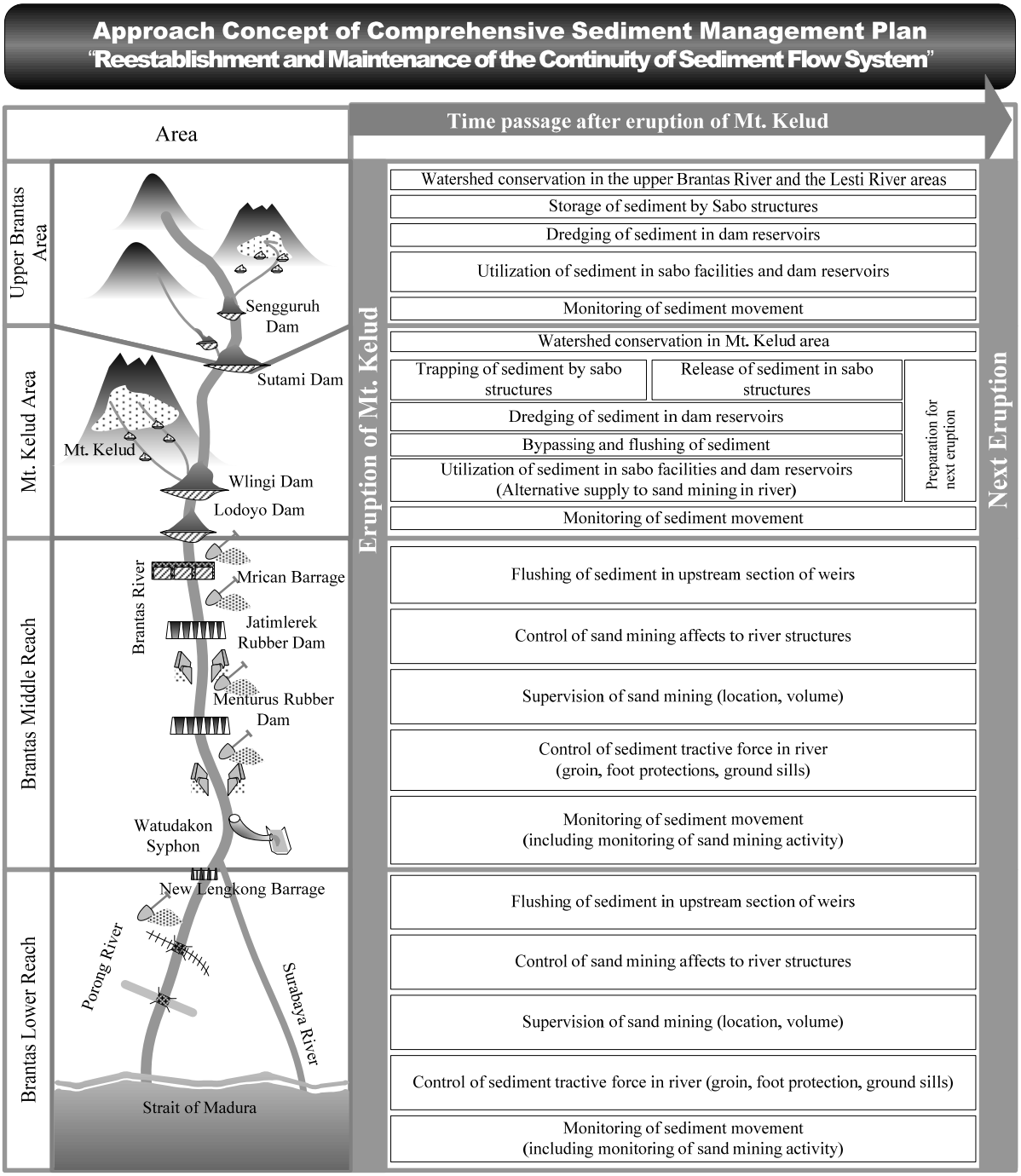
Phased Plan	Target Year	Sediment Management Plan	Remarks
Urgent Plan	2008	• Sabo plan (Urgent Sabo works) • Riverbed management plan	Implemented by the Project (WREFR & CIP) JBIC Loan No. IP-510; Design works are in progress as of year 2005.
Mid Term Plan	2025	• Watershed conservation M/P	• Upper Brantas River basin • Brangkal River basin • Lekso River basin • Upper Konto river basin
		• Sabo plan (Priority Sabo works)	• Sabo facilities on harmful rivers of Rank A
Long Term Plan	2050	• Sabo plan (Long term Sabo works)	• Sabo facilities on harmful rivers of Rank B and C
Continuous Management Plan		• Reservoir sediment management plan	Target reservoirs • Senggurh reservoir • Sutami reservoir • Wlingi reservoir • Lodoyo reservoir Sediment removal works by dredging and flushing
		• Control of sand mining in river	• Joint inspection, Simplification of licensing procedure, etc.
		• Alternative sand sources	• Excavation of sediment in Sabo facilities
		• Monitoring plan	

Source: "JBIC Loan Report" Main Report

Table H2.1.2 Outline of Sediment Management Plan in terms of Sediment Flow

Sediment Management Plan	Measures	Sediment Flow
Watershed conservation	• Planting works • Hill side works • Agro-forestry/terracing works • Retaining wall	• Reduce and control sediment yield and discharge • Decrease sediment inflow into reservoirs
Sabo Plan	• Construction of check dams, consolidation dams, sand pockets, sediment settlement pond, etc. • Construction of sand bypass channel • Construction of open type dams (slit type and conduit type dams)	• Debris flow occurrence control • Debris flow control • Decrease sediment inflow into reservoir • Release sediment to downstream
Reservoir sediment management	• Sediment removal works by dredging and flushing	• Restore storage capacity • Sediment supply to downstream section
Alternative sand sources	• Excavation of sediment in Sabo facilities • Dispersion of sand sources and workers	• To control large excess sediment amount by eruption • Decrease sand mining volume in river • Stabilizing of riverbed
Riverbed management plan	• Construction of ground sills	• Stabilize riverbed • Stabilize river and relevant structures
Control of sand mining	• Control of illegal sand mining • Simplification of licensing procedure • Enhancement of awareness of stakeholders	• Decrease sand mining volume in river • Stabilize riverbed

Source: "JBIC Loan Report" Main Report



Source: "JBIC Loan Report" Main Report

Figure H2.1.2 Conceivable Countermeasures in the Brantas River Basin

H2.2 Basin Sabo Plan

In this chapter, basin Sabo plan which does not described in POLA is described the main contents based on the report above.

H2.2.1 River Characteristics

(1) Distribution Characteristics of Material

As to riverbed material, the following distribution characteristics are observed (refer to Table H2.2.1).

- Riverbed material of the Lesti River consists of fine gravel and sand,
- Sediment in the Senggurh reservoir is formed with mostly silt and fine sand, and
- Sediment in existing sand pocket in Mt. Kelud area consists of fine sand and silt, because most of volcanic material consists of ash fall material.

Table H2.2.1 Grain Size Distribution of Sediment in Study Area

Location	Location	Wash load D < 0.1mm	Suspended Load 0.1 < d < 1.0mm	Bed load 1.0 mm<d	Data Source
Upper Brantas and Lesti Rivers	Lesti river	5%	25%	70%	Mt. Semeru Sub-project office
Senggurh Reservoir Sedimentation	Senggurh dam 2km upstream	27%	73%	0%	Survey result in May, 2004
	Senggurh dam axis	90%	10%	0%	
Mt. Kelud Area	Sand Pocket	15%	50%	35%	Mt. Kelud Sub-project office
Sutami Reservoir Sedimentation	2-5km from dam axis	95%	5 %	0%	Survey result in May, 2004
	100-500m from dam axis	85%	15%	0%	
Wlingi Reservoir Sedimentation	1 km from dam axis	90%	10%	0%	
	2km from dam axis	8%	82%	10%	
Lodoyo Reservoir Sedimentation	Average	95%	5%	0%	
Mrican Reservoir Sedimentation	Average	1%	85%	14%	
Selorejo Reservoir Sedimentation	Average	50%	40%	10%	

Source: "JBIC Loan Report" Supporting Report Annex No3

(2) Volcanic Activities and Debris Flow Occurrence

There exist several volcanoes in the Brantas River basin. Those are Mt. Arjuno, Mt. Anjasmoro, Mt. Butak, Mt. Kawi, Mt. Kelud, Mt. Bromo and Mt. Semeru. Mt. Semeru erupts continuously with large amount of ash fall, and Mt. Kelud has erupted on a large scale an average of once every 15 years.

In upper Brantas River basin, sediment sources are mainly slope failure, riverbank collapse, riverbed scoring and surface erosion. Cobble stones and boulders produced by slope failures are remained in the upper mountain streams and transported to downstream reaches during flood. After passing the confluence, eroded sediment is transported to main river channel with small grain sizes.

In Lesti River basin, sediment sources are mainly riverbank erosion, riverbed erosion and

surface erosion. There are a few slope failures in the upper area. The Lesti River originates from the northern slope of Mt. Semeru. Mt. Semeru is one of the active volcanoes in the Java Island, and pyroclastic flow occurs frequently in the southern slope. Since the Lesti River basin is located on the western slope of Mt. Semeru, only a few volcanic ash falls affect the Lesti River basin and ash deposits are composed of the fine-grained sediment.

In the Medium Brantas River basin, one of the sediment sources is pyroclastic flow deposits and ash fall deposits from Mt. Kelud, and depth of these deposits are generally 2-20 cm at the distance of 30 km from the summit. After it rains, deposited ash fall are conveyed to the downstream section in the form of wash and suspended loads.

(3) Rank Criteria of Debris Flow Rivers

To work out the effective measures against occurrence of debris flow, it is necessary to identify the harmful rivers (hazardous mountain stream) in the basin. All the rivers in project area were evaluated in terms of riverbed slope based on the available topographic map at a scale of 1/25,000, occurrence of debris flow in the past, conditions of slope failure, and effect of volcanic activity. The following evaluation criteria and scouring system were employed, in consideration of relationship between riverbed slope and conditions of debris flow, and past occurrence of debris flow, etc., (refer to Table H2.2.2 through Table H2.2.4).

Table H2.2.2 Evaluation Criteria

Item	Condition	Point
Riverbed slope	I > 3 degree	0
	I > 10 degree	1
	I > 20 degree	1
Slope failure	Exist	1
Effect of volcanic activity	Exist	1
Past debris flow occurrence	Exist	1

Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.3 Rank Criteria

Rank	Harmful State	Total Points
A	High	4 -5
B	Medium	3
C	Low	1 – 2

Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.4 Selected Harmful Debris Flow Rivers in the Brantas River Basin

Area	Upper Brantas	Medium Brantas	Mt. Kelud Volcanic Area	Lower Brantas	Total
Basin Block No.*	1,2,3,4,5,6,7, 8,9,10	11,12,17,18, 20,23,24	13,14,15,16, 19,21,22	25,26,27,28, 29,30,31,32	
A	4	0	8	1	13
B	7	9	9	10	35
C	13	8	10	16	47
Total	24	17	27	27	95

Source: "JBIC Loan Report" Supporting Report Annex No3, *: refer to Table H2.2.5

H2.2.2 Unstable Sediment Amount

(1) About Unstable Sediment

Unstable sediment is defined as sediment flowed out by the rain. For example, Surface soil disturbed by deforestation has the conditions which are likely to be eroded by rain. Cultivated land developed vastly is also put in the same one. Also, landslide, slope failure, riverbank erosion and riverbed erosion are source of sediment discharge. Sediment occurred by these phenomena is defined as "unstable sediment".

But, amount of unstable sediment is the volume which is presumed at the time of plan. And the volume is defined as the quantity estimated by only one calculation. Therefore, the figure does not include time parameter.

(2) Estimation Method

Unstable sediment can be estimated in consideration of two different sediment sources, which are 1) present unstable sediments and 2) future eruption products. Future eruption products are estimated based on the past eruption activities and added to the present unstable sediment. In this section, present unstable sediment amount was estimated.

Present unstable sediment amount is assumed to be composed of: 1) sediment amount by slope erosion and surface erosion, 2) sediment amount by slope failure, 3) sediment amount by riverbank erosion and 4) unstable sediment amount in riverbed.

Total unstable sediment amount (VT) is presented by the following equation:

$$V_T = V_{SE} + V_{SF} + V_{RB}$$

Where,

V_T : Total unstable sediment amount (m^3)

V_{SE} : Sediment amount by slope erosion and surface erosion (m^3)

V_{SF} : Sediment amount by slope failure (m^3)

V_{RB} : Unstable sediment amount in riverbed and bank erosion (m^3)

1) Slope Erosion and Surface Erosion Volume (U.S.L.E. Method)

The following formula was prepared from observation data in farmland and applied to determine the slope erosion and the surface erosion.

$$E_S = R \cdot K \cdot S \cdot L \cdot C \cdot P$$

Where,

ES : Anticipated annual mean erosion volume (ton/acre)
R : Coefficient of rainfall
K : Coefficient of soil erosion
S : Coefficient of slope angle
L : Coefficient of slope length
C : Planting management Coefficient
P : Coefficient of conservation

2) Sediment amount by slope failure

The following formula was employed to estimate sediment amount by slope failure, and the results of aerial-photo interpretation and field survey were considered for the estimation. In this study, aerial-photos taken in 1980 and 2004 were analyzed.

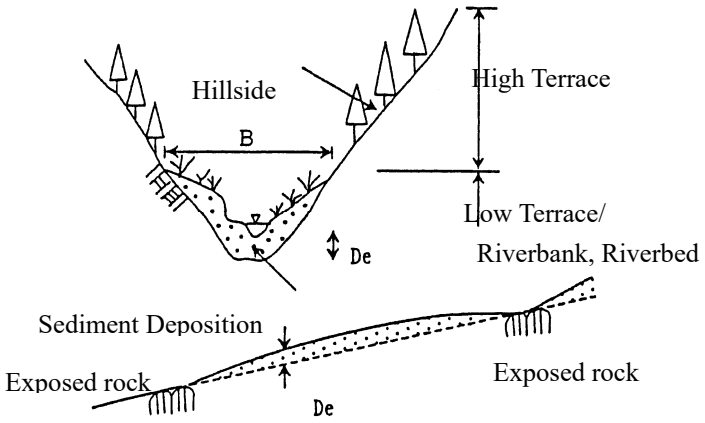
$$V_{SF} = B \cdot R \cdot d$$

Where,

VSF	:	Sediment amount by slope failure (m^3)	
B	:	Sub-basin area (m^2)	
R	:	Slope failure ratio (%)	R = 2 %
d	:	Mean depth of slope failure (m)	d = 3.0m

3) Unstable Sediment Amount in Riverbank and Riverbed

It was identified from field survey and aerial photograph interpretation that the riverbanks were composed of two different landforms of high terrace and low terrace as shown in Figure H2.2.1.



Source: "JBIC Loan Report" Supporting Report Annex No3

Figure H2.2.1 Unstable Sediment Material in Riverbed and Riverbank

Based on the field survey, unstable sediment amount in riverbed and riverbank in every river stretch of the targeted rivers was estimated as described below.

i) Potential unstable riverbed line was estimated by actual riverbed conditions, such as height between riverbed and river bank, gullies and depressions in riverbed.

ii) Potential unstable sediment was calculated by the following formula.

$$V_d = \frac{L \cdot (a_1 + a_2)}{2}$$

Where,

V_d : Amount of unstable riverbed sediments between sections (m^3)
L : Distance between sections (m)
a_1, a_2 : Area of unstable sediments in each section (m^2)

(3) Unstable Sediment Amount

Total unstable sediment amount, which is the sum of surface erosion volume estimated by USLE equation, slope failure volume and riverbed and riverbank unstable amount in each basin block, is summarized in Table H2.2.5.

According to the results, unstable sediment amount except for surface erosion volume are remarkably huge in the basin block of the Upper Brantas, Brangkal, Konto and Mt. Kelud volcanic area.

H2.2.3 Design Excess Sediment Discharge

(1) Estimation Method

The debris flow control plan was formulated based on the following formula;

$$X = Q - E$$
$$X - (B + C + D) = 0$$

Where,

X : Design excess sediment discharge
Q : Proposed sediment discharge
E : Allowable sediment discharge
B : Source sediment restraining amount
C : Regulating amount
D : Sediment deposition

The allowable sediment discharge (E) is a sediment amount that flows down without causing a disaster in the downstream section of the sediment control point in a selected harmful debris flow river. This value is usually zero (0), though it depends on the downstream conditions.

The sediment regulating amount (C) is a sediment amount captured by the debris flow control works. Occasionally, the capturing capacity (sediment regulating amount) is recovered naturally by small to medium-scale flooding that occurs following a debris flow.

The sediment deposition (D) is a sediment amount deposited by the debris flow control works. The deposit capacity will not be recovered naturally.

The source restraining amount (B) is a sediment amount prevented from causing a debris flow by various Sabo works installed in the debris flow occurrence section and flowing section.

As the proposed sediment discharge (Q), the smaller sediment amount, between total amount of present and future unstable sediment and possible sediment discharge by rainfall, is proposed.

Table H2.2.5 Total Unstable Sediment Amount by Basin Block

No.	Basin Block Name	Unstable Sediment Yield Volume					Future Volcanic Product		Catchment Area	Specific Unit Volume	
		Surface Erosion	Slope Failure / Riverbed			Total	Ash Deposit	Pyroclastic Deposit	Whole Area (Block Area)	Without Future Volcanic Product	With Future Volcanic Product
			Slope Failure	Riverbed / Riverbank	Sub-total						
		(m^3/year)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(km^2)	(m^3/km^2)	(m^3/km^2)
1	Upper Brantas	1,093,679	922,500	5,601,721	6,524,221	7,617,900			182.0	41,857	41,857
2	K. Bango-Sari	874,454	0	557,870	557,870	1,432,323			262.0	5,467	5,467
3	K. Amprong	3,335,779	500	4,933,004	4,933,504	8,269,283			348.0	23,762	23,762
4	K. Manten	744,359	0	155,316	155,316	899,675			217.0	4,146	4,146
5	Upper K. Lesti	2,806,825	103,500	2,562,095	2,665,595	5,472,420			258.0	21,211	21,211
6	K. Genteng	1,109,827	0	1,210,388	1,210,388	2,320,215			131.0	17,712	17,712
7	Lower K. Lesti-Jaruman	848,553	0	1,148,102	1,148,102	1,996,655			219.0	9,117	9,117
8	K. Metro	1,236,245	0	983,022	983,022	2,219,268			309.0	7,182	7,182
9	K. Ampo	790,180	0	45,347	45,347	835,527			188.0	4,444	4,444
10	K. Kedungbanteng	115,291	0	12,313	12,313	127,605			66.0	1,933	1,933
11	K. Bambang	1,128,131	0	173,613	173,613	1,301,744			273.0	4,768	4,768
12	K. Lemon-K. Putung	395,099	0	0	0	395,099			203.0	1,946	1,946
13	K. Lekso	2,021,582	3,045,000	7,728,476	10,773,476	12,795,059	1,526,000	13,500,000	145.0	88,242	191,869
14	K. Jari	541,282	0	1,364,689	1,364,689	1,905,971	2,916,000	0	87.0	21,908	55,425
15	K. Putih	376,835	0	3,408,306	3,408,306	3,785,141	8,152,000	4,500,000	52.0	72,791	316,099
16	K. Abab	1,254,775	0	511,965	511,965	1,766,740	8,388,000	800,000	379.0	4,662	28,904
17	K. Jimbe	321,542	0	0	0	321,542			275.0	1,169	1,169
18	K. Ngrowo	2,786,545	0	405,438	405,438	3,191,983			1,412.0	2,261	2,261
19	K. Badak-Sukorejo	1,355,942	0	10,001,774	10,001,774	11,357,716	25,364,000	20,500,000	702.0	16,179	81,512
20	K. Catut-K. Kedak	1,809,039	0	766,218	766,218	2,575,257			281.0	9,165	9,165
21	K. Konto	2,674,541	1,623,000	7,458,651	9,081,651	11,756,192	307,000	9,000,000	495.0	23,750	42,552
22	K. Ngobo- Serinjing	3,132,366	0	3,298,658	3,298,658	6,431,024	1,319,000	9,000,000	487.0	13,205	34,394
23	K. Amunger	3,041	0	0	0	3,041			234.0	13	13
24	K. Widas	5,604,163	0	377,458	377,458	5,981,621			1,294.0	4,623	4,623
25	K. Gunting	2,071,321	0	293,177	293,177	2,364,498			717.0	3,298	3,298
26	K. Turibaru	1,424	0	0	0	1,424			130.0	11	11
27	K. Beng	166,812	0	0	0	166,812			207.0	806	806
28	K. Brangkal	2,813,156	3,975,001	7,443,915	11,418,916	14,232,072			247.0	57,620	57,620
29	K. Sadar	843,454	0	376,970	376,970	1,220,424			535.0	2,281	2,281
30	K. Bangkok	680,756	0	297,110	297,110	977,867			124.0	7,886	7,886
31	K. Porong	445,905	0	380,916	380,916	826,820			340.0	2,432	2,432
32	K. Mas	233,179	0	0	0	233,179			1,189.0	196	196
Total		43,616,084	9,669,501	61,496,512	71,166,013	114,782,097	47,972,000	57,300,000	11,988	-	-

Source: “JBIC Loan Report” Supporting Report Annex No3

(2) Computation of Possible Sediment Discharge

1) Estimation Method

Possible sediment discharge by debris flow, which is defined as sediment discharge that river water can transport by its energy, was calculated by the following experimental equation, since actual debris flow data in the Study area was not available. The source of the following experimental equation is "Technical Guidelines for Debris Flow Control Measures, July 2000" introduced by Bureau of River, Ministry of Land, Infrastructure, and Transport, in Japan.

$$V_{ec} = \frac{10^3 \cdot R_t \cdot A}{1-\lambda} \cdot \left[\frac{C_d}{1-C_d} \right] \cdot f_r \quad \text{.....[2.1]}$$

$$C_d = \frac{\rho \cdot \tan\theta}{(\sigma - \rho) \cdot (\tan\phi - \tan\theta)} \quad \text{.....[2.2]}$$

($C_d = 0.9 \cdot C_*$ when $\theta \geq 20°$ or when $C_d \geq 0.9 \cdot C_*$, $C_d = 0.3$ when $C_d \leq 0.3$)

Where,

V_{ec} : Possible sediment discharge by debris flow (m^3)

R_t : Rainfall of design scale (mm)

In general, daily rainfall data is applied for calculation. However, to calculate annual possible sediment discharge, annual mean rainfall data was applied.

A : Basin area (km^2)

λ : Air porosity

f_r : Debris flow runoff rate

$f_r = 0.05 \cdot (\log A - 2.0)^2 + 0.05 \quad (0.1 \leq f_r \leq 0.5)$ .....[2.3]

C_d : Volumetric concentration of debris flow during flowing

C_* : Volumetric concentration of sediment ($C_* = 1 - \lambda$)

ρ : Water density (assumed to be 1.2 gr/cm^3)

σ : Stone density (gr/cm^3)

ϕ : Internal friction angle (degree)

θ : Riverbed slope (degree)

2) Critical Daily Rainfall

The data of critical rainfall for debris flow occurrences is not sufficient in the mountain stream in the Brantas River basin. On February 4, 2004, however, a debris flow occurred in the mountain stream of the upper Brantas River and caused the serious damage. The Pujon rainfall gauging station, which is the nearest rainfall gauging station of the upper Brantas River, observed 51 mm daily rainfall on February 3, 2004. In consideration of the actual occurrence of debris flow, in this study, daily rainfall of 50 mm/day was employed as the critical rainfall for debris flow occurrence in the Brantas River basin.

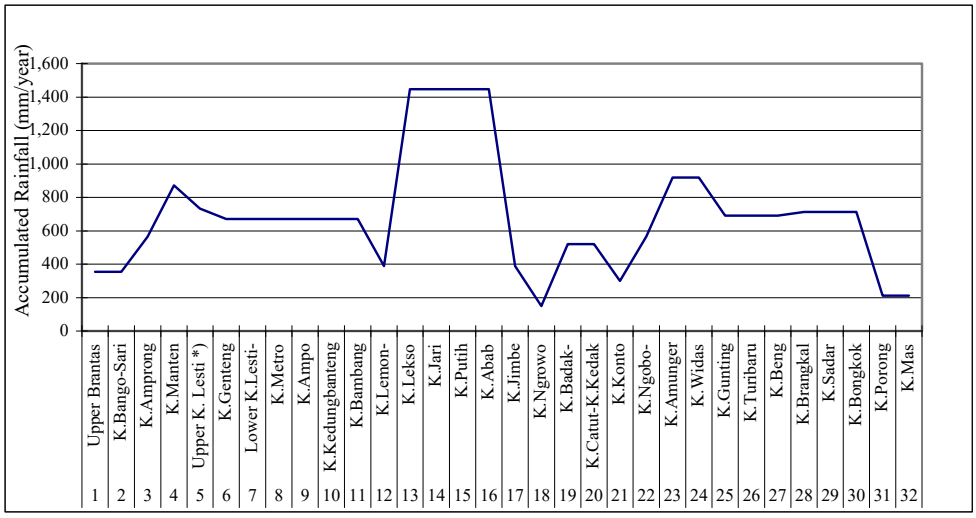
3) Computation Result

The sediment discharge was calculated using the equation [2.1] and [2.2]. The rainfall at the time of debris/flood flows are represented by daily rainfall at the selected rainfall stations. To compute an annual possible sediment discharge by debris flow, annual rainfall was adopted as a rainfall of design scale in the equation [2.1], and past 10 years available daily rainfall data was used to determine average rainfall depth. Annual mean accumulative rainfall is an annual total rainfall which exceeding the critical daily rainfall depth (50 mm/day). Distribution of annual mean accumulative rainfall in the Brantas River basin is shown in **Table H2.2.6** and **Figure H2.2.2.** Most intensive rainfalls range on the southern slope of Mt. Kelud area.

Table H2.2.6 Table Rainfall for Estimation of Possible Sediment Discharge

Basin Block No.	Rainfall Station Name	Critical Daily Rainfall (mm/day)	Annual Mean Accumulative Rainfall 1994-2003 (10 years average)
1, 2	Batu	50 mm	354 mm
3	Jabang		565mm
4	Tampang		871mm
5	Poncokusumo		732 mm
6,7,8,9,10,11	Dampit		670 mm
12,17	Lodoyo		389 mm
13,14,15,16	Semen		1,447 mm
18	Bendo		150 mm
19,20	Kediri		521 mm
21	Pujon		299 mm
22	Pare		566 mm
23,24	Sawahan		918 mm
25,26,27	Blimbing		690 mm
28,29,30	Tampung		712 mm
31,32	Porong		213 mm

Source: "JBIC Loan Report" Supporting Report Annex No3



Source: "JBIC Loan Report" Supporting Report Annex No3

Figure H2.2.2 Annual Mean Accumulated Rainfall Distribution in the Brantas River Basin

(3) Allowable Sediment Discharge (E)

Allowable sediment discharge is a discharge allowed to flow into downstream reach with harmless conditions. It is computed by the following sediment discharge equation introduced by Meyer-Peter Müller.

$$Q_{bl} = 8 (\tau_* - \tau_{*c})^{1.5} \sqrt{s.g.d^3}$$

$$\tau_* = u_*^2 / s.g.d$$

$$\tau_{*c} = u_{*c}^2 / s.g.d$$

Where ;

Q_{bl} : sediment discharge of bed load material per unit width (m^3/sec/m)
τ * : non-dimensional tractive force of bed load materials
τ *c : non-dimensional critical tractive force of bed load materials
u* : friction velocity of bed load materials (m/sec)
u*c : critical friction velocity of bed load materials (m/sec)
s : specific gravity of bed load materials in water (s = 1.65)
g : acceleration of gravity (g = 9.8 m/sec)
d : mean grain size of bed load materials (m)

In this study, proposed allowable sediment discharge for each river was set at zero (0), in consideration of safety of the downstream section and to minimize harmful sediment inflow into the existing dam reservoirs.

(4) Excess Sediment Discharge

Since allowable sediment discharge for each river was set at zero (0), proposed sediment discharge was adopted as the excess sediment discharge. Based on the results of the above study, proposed excess sediment discharge for each river was determined as shown in Table H2.2.7 through Table H2.2.9.

Table H2.2.7 Proposed Excess Sediment Discharge for Rank A Rivers

Basin Block No.	Name River	Rank of Harmful Debris Flow	Possible Sediment Discharge	Present Unstable Sediment	Proposed Sediment Discharge	Proposed Excess Sediment Discharge
			V_{cc} (m^3)	(m^3)	(m^3)	(m^3)
			(1)	(2)	(3)=Min(1),(2)	(4)
1	Brantas main stream	A	1,083,000	6,314,476	1,083,000	1,083,000
5	Lesti main stream	A	722,000	2,365,283	722,000	722,000
	K. Aran-Aran	A	875,000	123,161	123,161	123,161
8	K. Metro main stream	A	306,000	672,395	306,000	306,000
13	K. Lekso	A *)	394,000	8,356,933	394,000	394,000
	K. Semut	A *)	522,000	1,585,195	522,000	522,000
	K. Baraan	A *)	1,075,000	569,566	569,566	569,566
15	K. Putih	A *)	469,000	3,408,306	469,000	469,000
19	K. Badak	A *)	146,000	4,148,489	146,000	146,000
21	K. Konto	A *)	216,000	679,561	216,000	216,000
	K. Konto Left	A *)	135,000	750,000	135,000	135,000
22	K. Ngobo/Dermo	A *)	194,000	1,641,070	194,000	194,000
28	K. Jurangjetot	A	1,252,000	3,371,018	1,252,000	1,252,000

Note: *) Figures for rivers in Mt. Kelud area were calculated as normal conditions which is not including influence of volcanic eruption.
Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.8 Proposed Excess Sediment Discharge for Rank B Rivers

Basin Block No.	Name River	Rank of Harmful Debris Flow	Possible Sediment Discharge	Present Unstable Sediment	Proposed Sediment Discharge	Proposed Excess Sediment Discharge
			V_{ec} (m^3)	(m^3)	(m^3)	(m^3)
			(1)	(2)	(3)=Min(1),(2)	(4)
2	K. Glatik	B	255,000	80,839	80,839	80,839
5	K. Grangsel	B	351,000	34,996	34,996	34,996
	K. Bendo	B	248,000	47,168	47,168	47,168
8	K. Biru	B	188,000	45,242	45,242	45,242
	K. Gelondog	B	297,000	31,956	31,956	31,956
	K. Dem	B	398,000	56,996	56,996	56,996
9	K. Ampo	B	237,000	19,961	19,961	19,961
11	K. Sembung	B	318,000	36,579	36,579	36,579
	K. Tamak	B	373,000	50,175	50,175	50,175
	K. Genjong	B	460,000	68,489	68,489	68,489
13	Tributory of K. Lekso	B *)	1,374,000	261,782	261,782	261,782
14	K. Jari	B *)	124,000	1,364,689	124,000	124,000
18	K. Gunung	B	63,000	48,201	48,201	48,201
	K. Babakan	B	75,000	40,001	40,001	40,001
19	K. Gedok	B *)	114,000	1,512,978	114,000	114,000
	K. Petungkobong	B *)	52,000	1,523,913	52,000	52,000
	K. Sukorejo	B *)	66,000	2,697,388	66,000	66,000
20	K. Pandansari	B	239,000	55,110	55,110	55,110
	K. Bruno	B	519,000	139,630	139,630	139,630
21	K. Bentah	B	115,000	85,930	85,930	85,930
	K. Dadapan	B	104,000	49,706	49,706	49,706
	K. Ledok	B	142,000	1,781,108	142,000	142,000
22	K. Srinjing	B *)	80,000	1,657,588	80,000	80,000
24	K. Widas	B	479,000	44,330	44,330	44,330
	K. Kedungsoko	B	535,000	55,008	55,008	55,008
25	K. Pancir	B	956,000	106,650	106,650	106,650
	K. Bengawan	B	400,000	30,808	30,808	30,808
	K. Gogor	B	551,000	58,281	58,281	58,281
28	K. Gumeng	B	272,000	136,668	136,668	136,668
	K. Klera	B	450,000	413,910	413,910	413,910
	K. Kretek	B	1,398,000	2,884,138	1,398,000	1,398,000
30	K. Blanelong	B	367,000	43,256	43,256	43,256
31	K. Kedunglarangan	B	197,000	94,316	94,316	94,316
	K. Kedungbanger	B	130,000	60,175	60,175	60,175
	K. Sumberkajar	B	193,000	92,357	92,357	92,357

Note: *) Figures for rivers in Mt. Kelud area were calculated as normal conditions, which is not including influence of volcanic eruption.

Source: "JBIC Loan Report" Supporting Report Annex No3

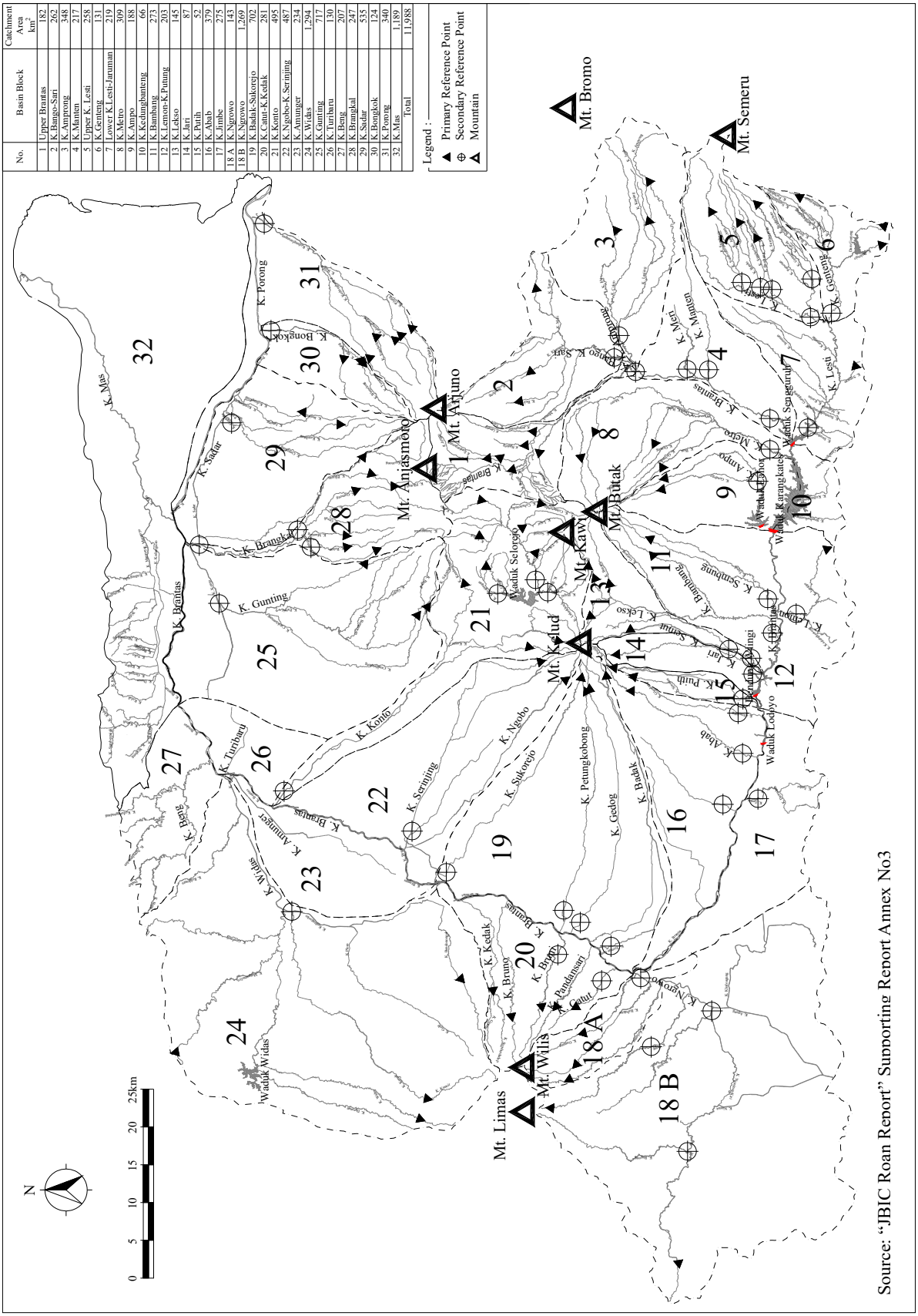
Table H2.2.9 Proposed Excess Sediment Discharge for Rank C Rivers

Basin Block No.	Name River	Rank of Harmful Debris Flow	Possible Sediment Discharge	Present Unstable Sediment	Proposed Sediment Discharge	Proposed Excess Sediment Discharge
			V_{ec} (m^3)	(m^3)	(m^3)	(m^3)
			(1)	(2)	(3)=Min(1),(2)	(4)
1	K. Mranak	C	71,000	4,585	4,585	4,585
	K. Sumber Gunung	C	194,000	48,679	48,679	48,679
	K. Junggo	C	316,000	106,020	106,020	106,020
2	K. Bandeng	C	140,000	35,613	35,613	35,613
3	K. Amprong	C	798,000	3,259,121	798,000	798,000
	K. Jilu	C	148,000	627,888	148,000	148,000
	K. Jarak	C	365,000	64,201	64,201	64,201
5	K. Bambang	C	367,000	47,486	47,486	47,486
	K. Bangsri	C	286,000	25,189	25,189	25,189
6	Genteng main stream	C	39,000	1,064,759	39,000	39,000
	K. Sumberancar	C	178,000	21,314	21,314	21,314
8	Tributory of K. Metro	C	699,000	106,854	106,854	106,854
9	K. Gendogo	C	266,000	25,386	25,386	25,386
11	K. Bambang	C	228,000	18,370	18,370	18,370
16	K. Glondong	C *)	-	40,442	-	-
	K. Abab	C *)	454,000	471,523	454,000	454,000
18	K. Kelantur	C	72,000	37,069	37,069	37,069
20	K. Catut	C	166,000	107,271	107,271	107,271
	K. Bruni	C	303,000	226,053	226,053	226,053
	K. Sumberdadap	C	243,000	35,560	35,560	35,560
	K. Gasang	C	319,000	60,452	60,452	60,452
21	K. Kandangbanteng	C	117,000	1,805,503	117,000	117,000
	K. Seloatap	C	257,000	834,503	257,000	257,000
	Tributory of K. Konto	C	96,000	175,579	96,000	96,000
	K. Kuwajangan	C	89,000	1,713,231	89,000	89,000
	K. Laharkletek	C	45,000	53,015	45,000	45,000
	K. Lajar	C	196,000	490,811	196,000	196,000
	K. Cobanrondo	C	202,000	662,704	202,000	202,000
24	K. Kuncir	C	2,004,000	229,392	229,392	229,392
	K. Ploso	C	503,000	48,728	48,728	48,728
25	K. Gunting	C	447,000	38,656	38,656	38,656
	K. Cetak banteng	C	413,000	32,918	32,918	32,918
28	K. Geruh	C	663,000	94,830	94,830	94,830
	K. Manting	C	350,000	39,352	39,352	39,352
	K. Roban	C	269,000	22,957	22,957	22,957
	K. Pikatan	C	1,238,000	3,206,613	1,238,000	1,238,000
	K. Kromong	C	410,000	1,111,531	410,000	410,000
	Tributory of K. Pikatan	C	895,000	129,855	129,855	129,855
29	K. Klengkeng	C	169,000	7,770	7,770	7,770
	K. Gembulu	C	384,000	47,390	47,390	47,390
	K. Cumpleng	C	586,000	83,221	83,221	83,221
	K. Kembang	C	363,000	42,394	42,394	42,394
30	K. Bangkok	C	1,199,000	175,855	175,855	175,855
	K. Tempuran	C	552,000	77,999	77,999	77,999
31	K. Banjar	C	193,000	92,044	92,044	92,044
	K. Pilang	C	108,000	42,024	42,024	42,024

Note: *) Figures for rivers in Mt. Kelud area were calculated as normal conditions, which is not including influence of volcanic eruption.

Source: "JBIC Loan Report" Supporting Report Annex No3

Sediment control reference points are the points where proposed sediment amount are determined in a sediment control plan. The sediment reference point was classified into two categories, which are Primary Reference point, and Secondary Reference point located at the most downstream section. The locations are shown in Figure H2.2.3.



Source: "JBIC Roan Report" Supporting Report Annex No3

Figure H2.2.3 Location of Sediment Control Reference Point

H2.2.4 Proposed Facilities

(1) Sediment Control Effect by Sabo Facilities

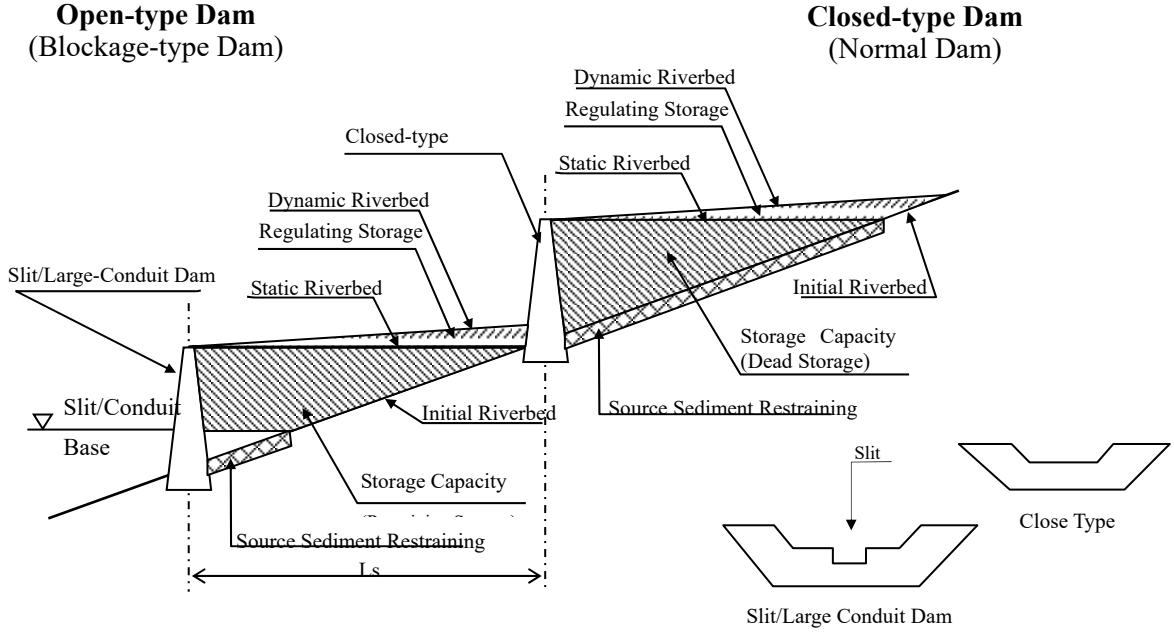
As shown in Figure H2.2.4, Sabo dam has generally sediment storage capacity, sediment discharge regulating volume, and source sediment restraining volume.

To estimate the sediment control volume, the following conditions were applied:

- The effect of source sediment restraining was not taken into account because a part of unstable sediment had been restrained by existing Sabo facilities,
- As to Sabo dams (check dams) and consolidation dams with more than 5 m height, only effect of sediment storage and sediment discharge regulation were taken into account,
- Open-type dams can flow down sediment as their own function during small or Medium scale flood, therefore, the effect of remaining sediment storage capacity and sediment discharge regulation was taken into account.

Based on the above conditions, sediment control effect considered in this study were as follows:

- Closed-type dam: Sediment Discharge Regulating Volume
- Open-type dam: Sediment Discharge Regulating Volume + Remaining Sediment Storage Capacity



Source: "JBIC Loan Report" Supporting Report Annex No3

Figure H2.2.4 Sediment Control by Sabo Dam

(2) Layout Plan of Sediment Control Works

Layout plan of debris flow disaster mitigation works was studied for the selected harmful rivers which have a high potential of debris flow occurrences.

To select the most suitable sediment control plan for each harmful river, the following conditions were considered.

For Rank A

- Locations and the scales of debris flow control works shall be determined in combination with debris flow occurrence control works (hillside work), Sabo dam works (deposition work), and debris flow direction control works.
- Sediment runoff works which control accumulated sediment loads, deposition works and sediment runoff regulation works shall be conducted. Since these measures are costly, combination with sand mining activities shall be considered to decrease sediment loads.

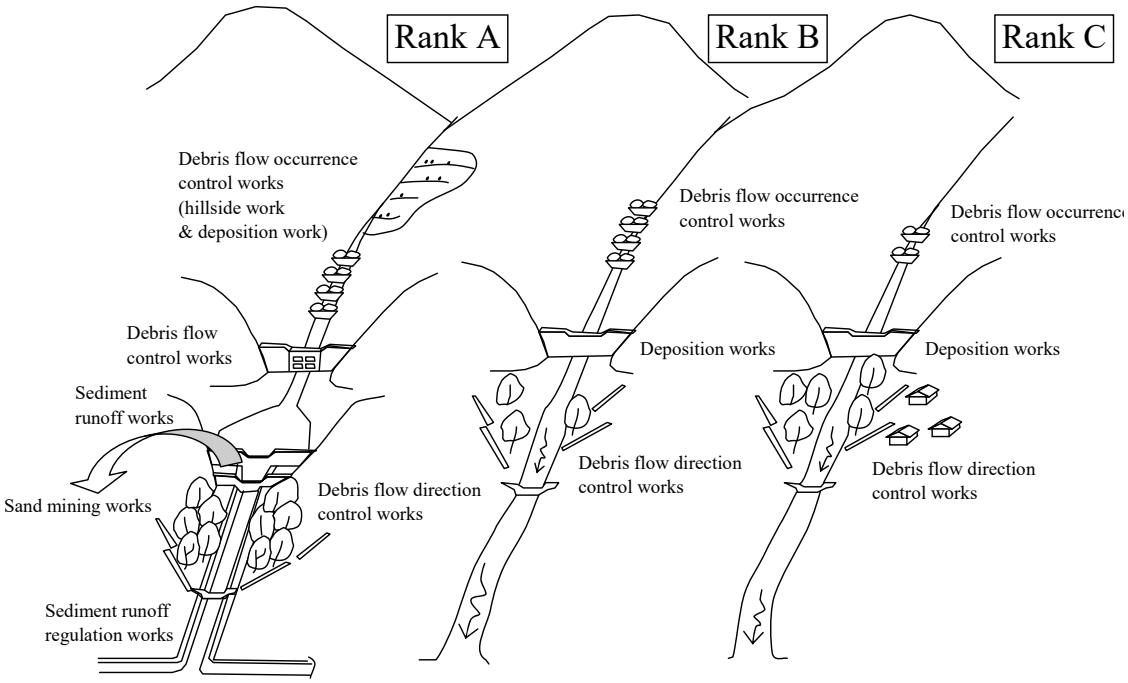
For Rank B

- Debris flow occurrence control works and deposition work with Sabo dam shall be proposed at the exit of a valley, and debris flow direction control works are required.
- Detailed inspection on sedimentation is required periodically as well as immediately after intensive rainfall.

For Rank C

- Debris flow occurrence control works and deposition work with Sabo dam shall be proposed at the exit of a valley, and debris flow direction control works are required.
- Detailed inspection on sedimentation is required periodically as well as immediately after intensive rainfall.

Layout plan of sediment control works for Rank A, B and C harmful rivers is illustrated in the following Figure H2.2.5.



Source: "JBIC Loan Report" Supporting Report Annex No3

Figure H2.2.5 Layout Plan of Sediment Control Works

Generally, Sabo facilities are constructed in the Medium and upper reaches to regulate boulder, gravel and sand materials transported from upstream devastated areas, however, a large quantity of small grain size sediment loads flow to downstream reaches during floods. To reduce the harmful sediment inflow to dam reservoirs on the Brantas River, if possible, Sabo dams located at just upstream section of the reservoirs are effective.

The characteristics of the sediment control facilities are shown in Table H2.2.10.

Table H2.2.10 Characteristics of Proposed Sediment Control Facility (Sabo Facility)

Facilities	Characteristics
1) Sabo Dam (Check dam)	Functions of a Sabo dam are to restrain sediment yield, to regulate sediment discharge and to storage sediment. A Sabo dam stabilizes riverbed to prevent a river channel from lateral and longitudinal erosion and sediment storage of a Sabo dam regulates the sediment discharge when flood occurred. Masonry and concrete are generally used to construct the Sabo dam in Indonesia. A Sabo dam height is more than 10m to 15m, it is set depending on the design excess sediment amount.
2) Consolidation Dam	A consolidation dam also stores sediment and stabilizes riverbed as a Sabo dam, as a result, control sediment yield and discharge. Masonry and concrete are generally used to construct the consolidation dam and gabion is used as the emergency measure. In Indonesia, if the dam height is more than 5.0 m, it is said as a consolidation dam.

Source: "JBIC Loan Report" Supporting Report Annex No3

(3) Priority Sediment Control Works

It is desirable to control proposed excess sediment discharge of each river by sediment control facilities; however, it is extremely difficult to raise such large funds in a short period. In this study, therefore, implementation of sediment control works was divided into the following three (3) stages (see Table H2.2.11).

1) Urgent Works

In consideration of present unstable sediment deposition in the upstream reaches of the Upper Brantas Main River and the Lesti River basins, the facilities as shown in Table H2.2.12 were proposed for the Urgent Works under JBIC IP-510 Project. The location of each proposed facility is shown in Figure H2.2.6.

These Sabo facilities were constructed as planned already by PJT1. On the other hand, "Reservoir Sedimentation Management Roadmap in the Brantas River Basin 2015-2019" was compiled in October 2014 by PJT1. Each facility is shown in Figure H2.2.7. But BRCD 7 was changed to BRCD 6.

2) Priority Works

The number of proposed Sabo facilities except for the Urgent works is listed in Table H2.2.13. The construction of proposed Sabo facilities on Rank B and C is shown in Table H2.2.14 and Table H2.2.15.

Table H2.2.11 Description of Sediment Control Works

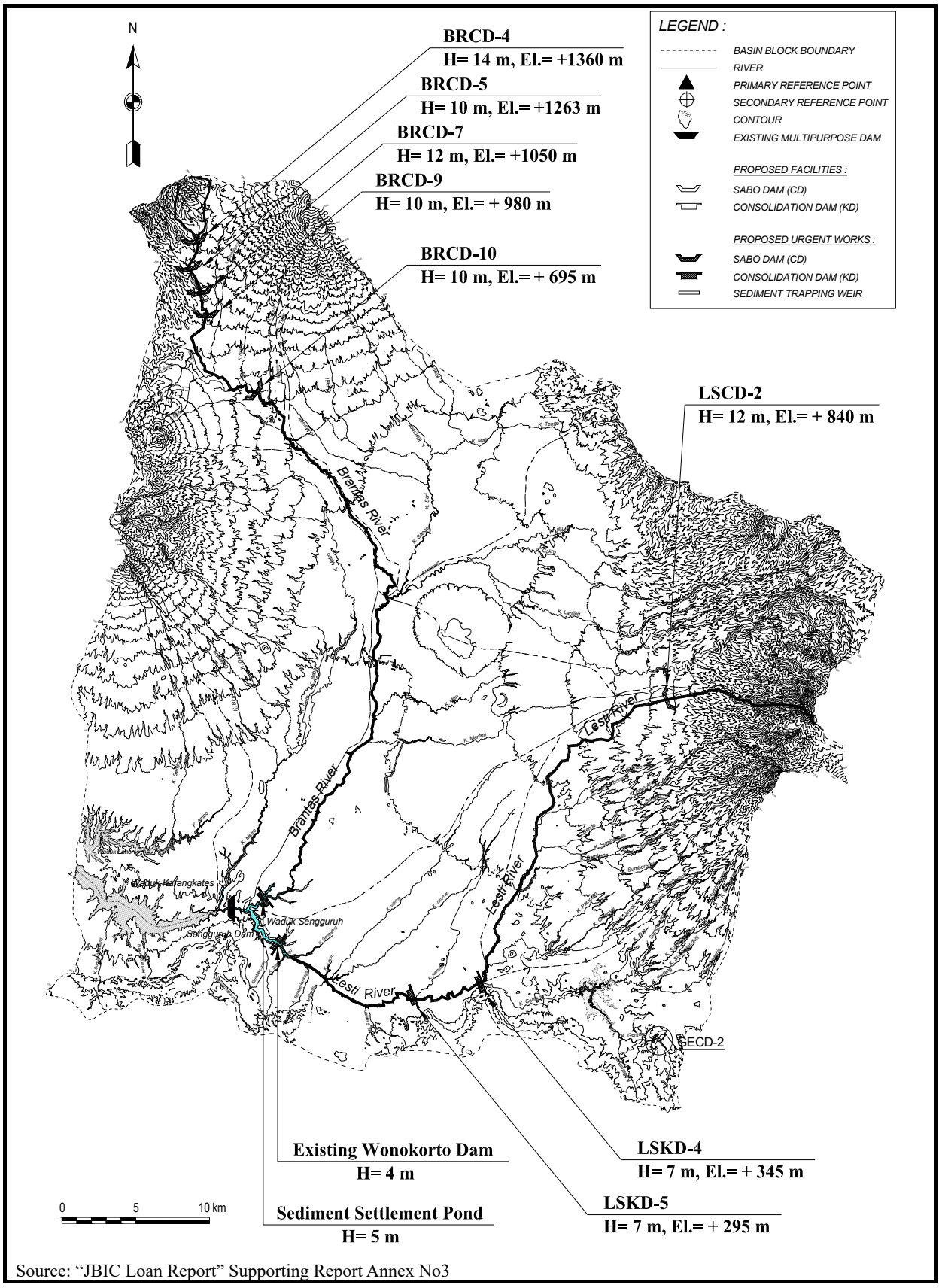
Works	Description
1.Urgent Works	Sabo facilities to be constructed by the Project (Water Resources Existing Facilities Rehabilitation and capacity project, JBIC Loan No.: IP-510) Target year for completion of priority works was set at **2008.**
2. Priority Works	Sabo facilities to be constructed on Rank A harmful rivers: 1. Upper Brantas 2. Upper Lesti River 3. Aranaran River 4. Upper Metro River 5. Baraan River (in the Lekso River basin) * 6. Upper Konto River 7. Jurangietot River (in the Brangkal River basin) Mt. Kelud Volcanic area * 8. Lekso River 9. Semut River 10. Ngobo River 11. Putih River 12. Badak River 13. Konto Left River Target year for completion of priority works was set at **2025**, which is the same target year as that for watershed conservation master plan. (Note: * Selected rivers in Mt. Kelud area)
3. Long Term Works	Sabo facilities to be constructed on Rank B and C harmful rivers. Target year for completion of long term works was set at **2050**.

Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.12 Proposed Sabo facilities for Urgent Works

Location /River	Name of Facility	Required height (m)	Sediment Storage Capacity (m^3)	Sediment Regulating Volume (m^3)	Source Sediment Restraining (m^3)	Total Controlled Volume (m^3)
Upper Brantas River	BRCD-4	14	191,200	253,700	51,000	495,900
	BRCD-5	10	85,000	127,500	34,000	246,500
	BRCD-7	12	161,000	57,100	51,500	269,600
	BRCD-9	10	131,300	65,900	52,500	249,700
	BRCD-10	10	110,100	54,800	44,000	208,900
Upstream most of Senggurh reservoir	Settlement pond	5	315,000	-	-	315,000
Lesti River	LSCD-2	12	130,900	175,200	41,900	348,000
	LSKD-4	7	1,330200	665,400	532,100	2,527,700
	LSKD-5	7	1,381,900	226,900	660,000	2,268,800
	Existing Wonokerto Dam	4	(675,000)	-	-	(675,000)
Total		**-**	**3,836,600**	**1,626,500**	**1,467,000**	**6,930,100**
Total with Existing Wonokerto dam			**(4,511,600)**	**-**	**-**	**(7,605,100)**

Source: "JBIC Loan Report" Supporting Report Annex No3



Source: "JBIC Loan Report" Supporting Report Annex No3

Figure H2.2.6 Proposed Facilities for Urgent Works

Source: Reservoir Sedimentation Management Roadmap in the Brantas River Basin 2015-2019; October 2014 PJT 1

Figure H2.2.7 Urgent Facilities

Table H2.2.13 Number of Selected Facility for the Priority Work

Basin Block No.	Rank of Harmful	River Name	Proposed Facility (Nos.)					
			CD		KD		SP	Total
			Open-type	Closed-type	Open-type	Closed-type	Dike	
1	A	Main Brantas	2	4	-	-	-	6
5		Lesti Main	-	2	-	-	-	2
		K. Aranaran	1	1	-	-	-	2
8		Metro Main	2	1	-	-	-	3
13		K. Baraan	3	1	-	-	-	4
21		Konto Main	-	1	-	3	2	6
28		K. Jurangjetot	2	1	-	-	-	3
Sub-total			10	11	-	3	2	26
Grand-total			21		3		2	

Remarks: CD: Sabo Dam/Check Dam; KD: Consolidation Dam; SP: Sand Pocket
Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.14 Proposed Sediment Control Facilities for Rank B Harmful Rivers

Basin Block No.	River	Proposed Facility (Nos.)				
		CD		KD		Total
		Open-type	Closed-type	Open-type	Closed-type	
2	K. Glatik	1	-	-	-	1
5	K. Grangsel	1	-	-	-	1
5	K. Bendo	-	1	-	-	1
8	K. Biru	-	1	-	-	1
8	K. Gelondog	1	-	-	-	1
8	K. Dem	-	1	-	-	1
9	K. Ampo	-	1	-	-	1
11	K. Sembung	-	1	-	-	1
11	K. Tapak/Tamak	1	-	-	-	1
11	K. Genjong	1	-	-	-	1
18	K. Gunung	-	1	-	-	1
18	K. Babakan	-	1	-	-	1
20	K. Pandansari	1	-	-	-	1
20	K. Bruno	-	3	-	-	3
21	K. Bentah	-	1	-	-	1
21	K. Dadapan	-	1	-	-	1
21	K. Ledok	-	3	-	-	3
24	K. Widas	-	1	-	-	1
24	K. Kedungsoko	-	1	-	-	1
25	K. Pancir	-	1	-	-	1
25	K. Bengawan	-	1	-	-	1
25	K. Gogor	1	-	-	-	1
28	K. Gumeng	1	2	-	-	3
28	K. Klera	1	1	-	-	2
28	K. Kretek	3	1	-	-	4
30	K. Blanelong	1	-	-	-	1
31	K. Kd.larangan	1	-	-	-	1
31	K. Kd. Banger	1	-	-	-	1
31	K. Sbr. Kajar	1	1	-	-	2
Sub-total		16	24	-	-	40
Total		40		0		

Remarks: CD: Sabo Dam / Check Dam, KD: Consolidation Dam
Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.15 Proposed Sediment Control Facilities for Rank C Harmful Rivers

Basin Block No.	River	Proposed Facility (Nos.)				
		CD		KD		Total
		Open-type	Closed-type	Open-type	Closed-type	
1	K. Mranak	-	1	-	-	1
1	Sumbergunung	-	1	-	-	1
1	Junggo	1	1	-	-	2
2	K. Bandeng	-	1	-	-	1
3	K. Amprong	2	-	-	-	2
3	K.Jilu	-	2	-	-	2
3	K.Jarak	1	-	-	-	1
5	K. Bambang	-	1	-	-	1
5	K. Bangsri	-	1	-	-	1
6	K. Genteng	1	-	-	1	2
6	K. Sbr. Ancar	-	1	-	-	1
8	K. Jemunang	1	-	-	-	1
9	K. Gendogo	-	1	-	-	1
11	K. Bambang	-	-	-	1	1
18	K. Kelantur	-	1	-	-	1
20	K. Catut	1	2	-	-	3
20	K. Bruni	2	1	-	-	3
20	K. Sumberdadap	-	1	-	-	1
20	K. Gasang	1	-	-	-	1
21	K. Kandang banteng	1	-	-	-	1
21	K. Seloatap	2	-	-	-	2
21	Tributary Konto	-	2	-	2	4
21	K. Kuwajangan	-	1	-	-	1
21	K. Pinjal (Confluence point)	-	1	-	-	1
21	K. Lahar.Kletek	-	1	-	-	1
21	K. Lajar	1	1	-	-	2
21	K. Coban rondo	2	-	-	-	2
24	K. Kuncir	1	1	-	-	2
24	K.Ploso	1	-	-	-	1
25	K. Gunting	-	1	-	-	1
25	K. Cetakbanteng	-	1	-	-	1
28	K. Geruh	-	1	-	1	2
28	K. Manting	-	1	-	-	1
28	K. Roban	-	1	-	-	1
28	K. Pikatan	6	1	-	-	7
28	K. Kromong	1	1	-	1	3
28	Trib. Pikatan	2	-	-	-	2
29	K. Klengkeng	-	1	-	-	1
29	K. Gembulu	-	1	-	-	1
29	K. Cumpleng	1	1	-	-	2
29	K. Kembang	-	1	-	-	1
30	K. Bangkok	1	1	-	-	2
30	K. Tempuran	1	-	-	-	1
31	K. Banjar	1	1	-	-	2
31	K. Pilang	-	1	-	-	1
	Sub-total	31	36	-	6	73
	Total		67		6	

Remarks: CD: Sabo Dam/ Check Dam, KD: Consolidation Dam
Source: "JBIC Loan Report" Supporting Report Annex No3

(4) Sediment Amount Controlled by the Proposed Facilities

Sediment amount controlled by the proposed facilities is shown in Table H2.2.16 and in Table H2.2.17.

Table H2.2.16 Sediment Improvement Ratio in Rank A, B Harmful Rivers (1/2)

Rank of Harmful	Basin Block No.	River Name	Proposed Excess Sediment Discharge	Proposed Facility of Sediment Control		
				Amount	Ratio	Judgement
Rank-A	1	Brantas main stream	1,083,000	1,088,200	100%	OK
	5	Lesti main stream	722,000	752,300	104%	OK
		K. Aran-Aran	123,161	137,900	112%	OK
	8	K. Metro main stream	306,000	308,200	101%	OK
	28	K. Jurangjetot	1,252,000	1,253,200	100%	OK
		Total	**3,486,161**	**3,539,800**		
Rank-B	2	K. Glatik	80,839	97,600	121%	OK
	5	K. Grangsel	34,996	50,100	143%	OK
		K. Bendo	47,168	53,800	114%	OK
	8	K. Biru	45,242	50,800	112%	OK
		K. Gelondog	31,956	40,200	126%	OK
		K. Dem	56,996	63,100	111%	OK
	9	K. Ampo	19,961	22,000	110%	OK
	11	K. Sembung	36,579	40,100	110%	OK
		K. Tamak	50,175	64,000	128%	OK
		K. Genjong	68,489	83,100	121%	OK
	18	K. Gunung	48,201	51,600	107%	OK
		K. Babakan	40,001	49,700	124%	OK
	20	K. Pandansari	55,110	69,500	126%	OK
		K. Bruno	139,630	148,900	107%	OK
	21	K. Bentah	85,930	88,000	102%	OK
		K. Dadapan	49,706	71,700	144%	OK
		K. Ledok	142,000	212,200	149%	OK
	24	K. Widas	44,330	67,000	151%	OK
		K. Kedungsoko	55,008	72,000	131%	OK
	25	K. Pancir	106,650	125,600	118%	OK
		K. Bengawan	30,808	32,700	106%	OK
		K. Gogor	58,281	67,100	115%	OK
	28	K. Gumeng	136,668	151,700	111%	OK
		K. Klera	413,910	496,100	120%	OK
		K. Kretek	1,398,000	1,447,200	104%	OK
	30	K. Blanelong	43,256	51,400	119%	OK
	31	K. Kedunglarangan	94,316	128,900	137%	OK
		K. Kedungbanger	60,175	67,000	111%	OK
		K. Sumberkajar	92,357	95,600	104%	OK
		Total	**3,566,737**	**4,058,700**		

Source: "JBIC Loan Report" Supporting Report Annex No3

Table H2.2.17 Sediment Improvement Ratio in Rank C Harmful Rivers (2/2)

Rank of Harmful	Basin Block No.	River Name	Proposed Excess Sediment Discharge	Proposed Facility of Sediment Control		
				Amount	Ratio	Judgement
Rank-C	1	K. Mranak	4,585	-	-	-
		K. Sumber Gunung	48,679	48,700	100%	OK
		K. Junggo	106,020	119,300	113%	OK
	2	K. Bandeng	35,613	43,600	122%	OK
	3	K. Amprong	798,000	813,500	102%	OK
		K. Jilu	148,000	149,600	101%	OK
		K. Jarak	64,201	95,500	149%	OK
	5	K. Bambang	47,486	54,800	115%	OK
		K. Bangsri	25,189	30,200	120%	OK
	6	Genteng main stream	39,000	45,900	118%	OK
		K. Sumberancar	21,314	31,500	148%	OK
	8	Tributory of K. Metro	106,854	-	-	-
	9	K. Gendogo	25,386	38,600	152%	OK
	11	K. Bambang	18,370	20,800	113%	OK
	18	K. Kelantur	37,069	49,500	134%	OK
	20	K. Catut	107,271	128,700	120%	OK
		K. Bruni	226,053	228,300	101%	OK
		K. Sumberdadap	35,560	49,100	138%	OK
		K. Gasang	60,452	63,400	105%	OK
	21	K. Kandangbanteng	117,000	128,600	110%	OK
		K. Seloatap	257,000	257,200	100%	OK
		Tributory of K. Konto	96,000	143,700	150%	OK
		K. Kuwajangan	89,000	99,200	111%	OK
		K. Laharkletek	45,000	88,000	196%	OK
		K. Lajar	196,000	296,700	151%	OK
		K. Cobanrondo	202,000	221,500	110%	OK
	24	K. Kuncir	229,392	242,600	106%	OK
		K. Ploso	48,728	53,200	109%	OK
	25	K. Gunting	38,656	58,100	150%	OK
		K. Cetak banteng	32,918	47,900	146%	OK
	28	K. Geruh	94,830	95,000	100%	OK
		K. Manting	39,352	48,600	124%	OK
		K. Roban	22,957	34,700	151%	OK
		K. Pikatan	1,238,000	1,361,800	110%	OK
		K. Kromong	410,000	413,100	101%	OK
		Tributory of K. Pikatan	129,855	140,300	108%	OK
	29	K. Klengkeng	7,770	11,200	144%	OK
		K. Gembulu	47,390	52,200	110%	OK
		K. Cumpleng	83,221	83,800	101%	OK
		K. Kembang	42,394	52,100	123%	OK
	30	K. Bangkok	175,855	192,700	110%	OK
		K. Tempuran	77,999	90,400	116%	OK
	31	K. Banjar	92,044	103,700	113%	OK
		K. Pilang	42,024	45,100	107%	OK
		Total	**5,810,487**	**6,372,400**		

Source: "JBIC Loan Report" Supporting Report Annex No3"

(5) Estimated Direct Cost of proposed Facilities in Upper Brantas River Basin

Estimated Direct Cost of proposed Facilities in Upper Brantas River Basin is shown in Table H2.2.18 and in Table H2.2.19.

Table H2.2.18 Estimated Direct Cost of proposed Facilities (1/2)

As of May 2004, 1 Yen= Rp 78.44

Works	Rank of Harmful	Basin Block No.	River Name	Name of Facility	Estimated Cost					
					Each Portion		Total Cost by Each Facility		Total Cost by River	
					FC (¥)	LC (Rp)	Equivalent in Yen (¥)	Equivalent in Rupiah (Rp)	Equivalent in Yen (¥)	Equivalent in Rupiah (Rp)
(a)	(b)	(c)	(d)	(e)	(ak)	(al)	(am)	(an)	(ao)	(ap)
Urgent Work	Rank A	1	Upper Brantas Main	BRCD-4	52,696,181	4,115,332,997	105,160,906	8,248,821,448	452,972,791	35,531,185,748
		1	Upper Brantas Main	BRCD-5	35,589,339	2,711,038,576	70,151,279	5,502,666,290		
		1	Upper Brantas Main	BRCD-7	49,729,023	3,820,438,897	98,434,261	7,721,183,432		
		1	Upper Brantas Main	BRCD-9	30,678,113	2,353,493,477	60,681,854	4,759,884,631		
		1	Upper Brantas Main	BRCD-10	35,589,339	2,711,038,576	70,151,279	5,502,666,290		
		1	Upper Brantas Main	Sediment Settlement Ponds	26,041,878	1,753,238,716	48,393,213	3,795,963,658		
		5	Upper Lesti Main	LSCD-2	43,638,472	3,371,501,729	86,620,392	6,794,503,512	236,294,363	18,534,929,853
		7	Lower Lesti Main	LSKD-4	39,911,842	2,706,866,236	74,420,591	5,837,551,122		
		7	Lower Lesti Main	LSKD-5	40,365,049	2,736,640,802	75,253,381	5,902,875,219		
	Total for Urgent Work								**689,267,155**	**54,066,115,601**
Priority Work	Rank A	1	Upper Brantas Main	BRCD-1	30,678,113	2,353,493,477	60,681,854	4,759,884,631	535,280,686	41,987,417,038
		1	Upper Brantas Main	BRCD-2	30,678,113	2,353,493,477	60,681,854	4,759,884,631		
		1	Upper Brantas Main	BRCD-3	52,696,181	4,115,332,997	105,160,906	8,248,821,448		
		1	Upper Brantas Main	BRCD-6	52,696,181	4,115,332,997	105,160,906	8,248,821,448		
		1	Upper Brantas Main	BRCD-8	49,729,023	3,820,438,897	98,434,261	7,721,183,432		
		1	Upper Brantas Main	BRCD-11	52,696,181	4,115,332,997	105,160,906	8,248,821,448		
		5	Lesti Main	LSCD-1	52,696,181	4,115,332,997	105,160,906	8,248,821,448	210,321,812	16,497,642,896
		5	Lesti Main	LSCD-3	52,696,181	4,115,332,997	105,160,906	8,248,821,448		
		5	K.Aranaran	ARCD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157	141,679,223	11,113,318,252
		5	K.Aranaran	ARCD-2	32,005,435	2,499,210,792	63,866,868	5,009,717,094		
		8	Metro main	MECD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157	205,546,091	16,123,035,346
		8	Metro main	MECD-2	32,005,435	2,499,210,792	63,866,868	5,009,717,094		
		8	Metro main	MECD-3	32,005,435	2,499,210,792	63,866,868	5,009,717,094		
		21	Konto Main	KOCD-1	60,683,299	4,622,590,040	119,614,839	9,382,587,992	119,614,839	9,382,587,992
		28	K. Jurangjetot	JJCD-1	64,237,097	4,950,176,920	127,344,911	9,988,934,826	385,430,248	30,233,148,636
		28	K. Jurangjetot	JJCD-2	65,459,411	4,987,470,695	129,042,668	10,122,106,905		
		28	K. Jurangjetot	JJCD-3	65,459,411	4,987,470,695	129,042,668	10,122,106,905		
	Total for Priority Work								**1,597,872,899**	**125,337,150,160**
Long Term Works(Rank B)	Rank B	2	K. Glatik	GLCD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157	77,812,355	6,103,601,157
		5	K. Grangsel	GRCD-1	32,177,683	2,541,260,286	64,575,188	5,065,277,724	116,079,022	9,105,238,503
		5	K Bendo	BECD-1	25,949,574	2,004,476,178	51,503,835	4,039,960,780		
		8	K. Biru	BICD-1	25,949,574	2,004,476,178	51,503,835	4,039,960,780	193,183,058	15,153,279,031
		8	K.Gelondog	GECD-1	32,005,435	2,499,210,792	63,866,868	5,009,717,094		
		8	K.Dem	DECD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157		
		9	K. Ampo	AMCD-1	28,291,007	2,177,918,853	56,056,419	4,397,065,479	56,056,419	4,397,065,479
		11	K. Sembung	SECD-1	37,242,513	2,923,270,547	74,510,113	5,844,573,256	210,201,217	16,488,183,432
		11	K. Tapak/Tamak	TACD-1	30,706,592	2,390,411,879	61,180,991	4,799,036,919		
		11	K. Genjong	GECD-1	37,242,513	2,923,270,547	74,510,113	5,844,573,256		
		18	K. Gunung	GUCD-1	36,021,247	2,787,573,182	71,558,896	5,613,079,775	132,389,141	10,384,604,220
		18	K. Babakan	BACD-1	30,541,444	2,375,853,597	60,830,245	4,771,524,445		
		20	K. Pandansari	PACD-1	28,729,049	2,209,230,209	56,893,636	4,462,736,817	247,848,369	19,441,226,077
		20	K. Bruno	BOCD-1	31,319,465	2,402,015,042	61,941,788	4,858,713,858		
		20	K. Bruno	BOCD-2	31,319,465	2,402,015,042	61,941,788	4,858,713,858		
		20	K. Bruno	BOCD-3	33,959,511	2,597,277,529	67,071,157	5,261,061,544		
		21	K. Bentah	BECD-1	45,015,996	3,403,104,012	88,400,800	6,934,158,751	176,801,600	13,868,317,502
		21	K. Dadapan	DACD-1	45,015,996	3,403,104,012	88,400,800	6,934,158,751		
		21	K. Ledok	LECD-1	50,842,020	3,820,883,176	99,552,922	7,808,931,230	266,177,002	20,878,924,005
		21	K. Ledok	LECD-2	50,842,020	3,820,883,176	99,552,922	7,808,931,230		
		21	K. Ledok	LECD-3	33,959,511	2,597,277,529	67,071,157	5,261,061,544		
		24	K. Widas	WICD-1	21,403,723	1,663,986,678	42,617,220	3,342,894,736	94,121,055	7,382,855,516
		24	K. Kedungsoko	KECD-1	25,949,574	2,004,476,178	51,503,835	4,039,960,780		
		25	K. Pancir	PACD-1	29,464,030	2,433,147,844	60,483,252	4,744,306,324	187,569,338	14,712,938,846
		25	K. Bengawan	BECD-1	32,431,125	2,680,428,744	66,602,833	5,224,326,197		
		25	K. Gogor	GOCD-1	29,464,030	2,433,147,844	60,483,252	4,744,306,324		
		28	K. Gumeng	GUCD-1	37,005,737	2,901,660,247	73,997,836	5,804,390,266	913,497,761	71,654,764,374
		28	K. Gumeng	GUCD-2	30,524,962	2,373,735,596	60,786,763	4,768,113,651		
		28	K. Gumeng	GUCD-3	24,777,595	1,905,820,778	49,074,138	3,849,375,350		
		28	K. Klera	KLCD-1	64,237,097	4,950,176,920	127,344,911	9,988,934,826		
		28	K. Klera	KLKD-2	31,936,574	2,302,345,832	61,288,255	4,807,450,722		
		28	K. Kretek	KRECD-1	67,096,681	5,185,019,741	133,198,411	10,448,083,390		
		28	K. Kretek	KRECD-2	67,096,681	5,185,019,741	133,198,411	10,448,083,390		
		28	K. Kretek	KRECD-3	67,096,681	5,185,019,741	133,198,411	10,448,083,390		
		28	K. Kretek	KRECD-4	71,499,153	5,483,855,842	141,410,625	11,092,249,389		
		30	K. Blanelong	BICD-1	30,956,107	2,400,057,286	61,553,471	4,828,254,294	61,553,471	4,828,254,294
		31	K. Kd.larangan	KICD-1	37,463,164	2,929,257,089	74,807,084	5,867,867,671	247,715,811	19,430,828,225
		31	K. Kd. Banger	KBCD-1	30,956,107	2,400,057,286	61,553,471	4,828,254,294		
		31	K. Sbr. Kajar	SBCD-1	30,956,107	2,400,057,286	61,553,471	4,828,254,294		
		31	K. Sbr. Kajar	SBCD-2	25,184,706	1,930,963,659	49,801,784	3,906,451,965		
	Total for Long Term Work (Rank B)								**2,981,005,618**	**233,830,080,662**

Source: "JBIC Loan Report; DataBook_SABO"

Table H2.2.19 Estimated Direct Cost of proposed Facilities (2/2)

Rank C	1	K. Mranak	MRCD-1	25,949,574	2,004,476,178	51,503,835	4,039,960,780	249,879,374	19,600,538,126
	1	Sumbergunung	SGCD-1	35,323,315	2,770,382,343	70,641,805	5,541,143,157		
	1	Junggo	JUCD-1	32,005,435	2,499,210,792	63,866,868	5,009,717,094		
	1	Junggo	JUCD-2	32,005,435	2,499,210,792	63,866,868	5,009,717,094		
	2	K. Bandeng	BDCD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157	77,812,355	6,103,601,157
	3	K. Amprong	AMCD-1	49,162,252	3,847,657,671	98,214,491	7,703,944,697	427,151,620	33,505,773,109
	3	K. Amprong	AMCD-2	49,162,252	3,847,657,671	98,214,491	7,703,944,697		
	3	K.Jilu	JICD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157		
	3	K.Jilu	JICD-2	38,834,495	3,057,423,391	77,812,355	6,103,601,157		
	3	K.Jarak	JACD-1	37,730,610	2,931,092,361	75,097,927	5,890,681,399		
	5	K. Bambang	BACD-1	29,238,376	2,301,867,039	58,583,953	4,595,325,252	101,201,173	7,938,219,989
	5	K. Bangsri	BBCD-1	21,403,723	1,663,986,678	42,617,220	3,342,894,736		
	6	K. Genteng	GECD-1	37,730,610	2,931,092,361	75,097,927	5,890,681,399	169,084,996	13,263,027,091
	6	K. Genteng	GEKD-2	21,769,780	1,624,763,370	42,483,234	3,332,384,912		
	6	K. Sbr. Ancar	SACD-1	25,949,574	2,004,476,178	51,503,835	4,039,960,780		
	8	K. Jemunang	JMCD-1	32,005,435	2,499,210,792	63,866,868	5,009,717,094	63,866,868	5,009,717,094
	9	K. Gendogo	GECD-1	19,199,306	1,496,939,853	38,283,190	3,002,933,393	38,283,190	3,002,933,393
	11	K. Bambang	BAKD-1	20,934,532	1,557,204,874	40,786,710	3,199,309,545	40,786,710	3,199,309,545
	18	K. Kelantur	KECD-2	30,541,444	2,375,853,597	60,830,245	4,771,524,445	60,830,245	4,771,524,445
	20	K. Catut	CACD-1	28,729,049	2,209,230,209	56,893,636	4,462,736,817	453,658,919	35,585,005,600
	20	K. Catut	CACD-2	28,729,049	2,209,230,209	56,893,636	4,462,736,817		
	20	K. Catut	CACD-3	28,729,049	2,209,230,209	56,893,636	4,462,736,817		
	20	K. Bruni	BICD-1	34,708,841	2,692,357,842	69,032,628	5,414,919,321		
	20	K. Bruni	BICD-2	31,319,465	2,402,015,042	61,941,788	4,858,713,858		
	20	K. Bruni	BICD-3	27,790,824	2,097,814,551	54,535,017	4,277,726,765		
	20	K. Sumberdadap	SUCD-1	23,424,639	1,780,933,122	46,129,039	3,618,361,823		
	20	K. Gasang	GACD-1	25,992,421	1,988,227,847	51,339,538	4,027,073,382		
	21	K. Kandang banteng	BACD-1	33,959,511	2,597,277,529	67,071,157	5,261,061,544	978,137,520	76,725,107,106
	21	K. Seloatap	SECD-1	37,335,033	2,870,750,066	73,933,070	5,799,310,042		
	21	K. Seloatap	SECD-2	33,959,511	2,597,277,529	67,071,157	5,261,061,544		
	21	Tributary K. Konto	KRCD-1	42,762,290	3,310,635,182	84,968,245	6,664,909,174		
	21	Tributary K. Konto	KRCD-2	27,790,824	2,097,814,551	54,535,017	4,277,726,765		
	21	Tributary K. Konto	KRKD-1	21,697,793	1,584,057,090	41,892,299	3,286,031,970		
	21	Tributary K. Konto	KRKD-2	21,697,793	1,584,057,090	41,892,299	3,286,031,970		
	21	K. Kuwajangan	KWCD-1	28,729,049	2,209,230,209	56,893,636	4,462,736,817		
	21	K. Pinjal	PICD-1	42,080,502	3,107,922,528	81,702,156	6,408,717,096		
	21	K. Lahar Kletek	LKCD-1	45,015,996	3,403,104,012	88,400,800	6,934,158,751		
	21	K. Lajar	LACD-1	45,015,996	3,403,104,012	88,400,800	6,934,158,751		
	21	K. Lajar	LACD-2	50,842,020	3,820,883,176	99,552,922	7,808,931,230		
	21	K. Cobanrondo	COCD-1	34,708,841	2,692,357,842	69,032,628	5,414,919,321		
	21	K. Cobanrondo	COCD-2	31,634,522	2,443,940,207	62,791,333	4,925,352,130		
	24	K. Kuncir	KUCD-1	32,005,435	2,499,210,792	63,866,868	5,009,717,094	216,777,150	17,003,999,651
	24	K. Kuncir	KUCD-2	37,730,610	2,931,092,361	75,097,927	5,890,681,399		
	24	K.Ploso	PLCD-1	38,834,495	3,057,423,391	77,812,355	6,103,601,157		
	25	K. Gunting	GUCD-1	24,046,889	1,981,718,508	49,311,020	3,867,956,444	89,851,082	7,047,918,896
	25	K. Cetakbanteng	CECD-1	19,757,376	1,630,193,869	40,540,062	3,179,962,451		
	28	K. Geruh	GRCD-1	33,673,674	2,630,196,693	67,204,993	5,271,559,669	1,397,270,652	109,601,909,976
	28	K. Geruh	GRKD-1	35,992,013	2,570,365,298	68,760,566	5,393,578,766		
	28	K. Manting	MACD-1	29,313,658	2,239,148,755	57,859,665	4,538,512,104		
	28	K. Roban	ROCD-1	24,777,595	1,905,820,778	49,074,138	3,849,375,350		
	28	K. Pikatan	PICD-1	50,258,045	3,908,678,781	100,088,218	7,850,919,807		
	28	K. Pikatan	PICD-2	50,258,045	3,908,678,781	100,088,218	7,850,919,807		
	28	K. Pikatan	PICD-3	50,258,045	3,908,678,781	100,088,218	7,850,919,807		
	28	K. Pikatan	PICD-4	50,258,045	3,908,678,781	100,088,218	7,850,919,807		
	28	K. Pikatan	PICD-5	58,738,891	4,498,776,091	116,091,978	9,106,254,719		
	28	K. Pikatan	PICD-6	59,742,101	4,517,809,618	117,337,838	9,203,979,982		
	28	K. Pikatan	PICD-7	49,274,772	3,658,659,677	95,917,552	7,523,772,815		
	28	K. Kromong	KRCD-1	37,005,737	2,901,660,247	73,997,836	5,804,390,266		
	28	K. Kromong	KRCD-2	43,541,048	3,400,859,563	86,897,238	6,816,219,352		
	28	K. Kromong	KRKD-1	58,738,891	4,498,776,091	116,091,978	9,106,254,719		
	28	Trib. Pikatan	TPICD-1	43,541,048	3,400,859,563	86,897,238	6,816,219,352		
	28	Trib. Pikatan	TPICD-2	30,524,962	2,373,735,596	60,786,763	4,768,113,651		
	29	K. Klengkeng	KICD-1	20,423,219	1,581,112,703	40,580,188	3,183,109,964	280,845,909	22,029,553,063
	29	K. Gembulu	GECD-1	32,076,399	2,500,090,837	63,949,051	5,016,163,587		
	29	K. Cumpleng	CUCD-1	30,524,962	2,373,735,596	60,786,763	4,768,113,651		
	29	K. Cumpleng	CUCD-2	27,559,603	2,132,276,958	54,743,144	4,294,052,211		
	29	K. Kembang	KECD-1	30,524,962	2,373,735,596	60,786,763	4,768,113,651		
	30	K. Bangkok	BACD-1	34,117,678	2,657,143,916	67,992,537	5,333,334,602	185,786,858	14,573,121,168
	30	K. Bangkok	BACD-2	25,184,706	1,930,963,659	49,801,784	3,906,451,965		
	30	K. Tempuran	TECD-1	34,117,678	2,657,143,916	67,992,537	5,333,334,602		
	31	K. Banjar	BACD-1	30,956,107	2,400,057,286	61,553,471	4,828,254,294	172,908,727	13,562,960,554
	31	K. Banjar	BACD-2	25,184,706	1,930,963,659	49,801,784	3,906,451,965		
	31	K. Pilang	PICD-1	30,956,107	2,400,057,286	61,553,471	4,828,254,294		
Total for Long Term Work (Rank C)								**5,004,133,350**	**392,524,219,962**
Grand Total								**10,272,279,021**	**805,757,566,385**

Source: "JBIC Loan Report; DataBook_SABO"

H2.2.5 About Role of Sabo Facility and Fine-Grained Sediment

The relation between issue of sediment deposited in the existing dam reservoirs of Brantas River and role of Sabo facilities described in Annex No8 (Sediment Management Plan) of the report above is as follows;

"Sediment deposited in these dam reservoirs is dominated by fine-grained silt and clay. The fine-grained sediment, which is mainly due to surface erosion on the upstream areas, is transported into these reservoirs as suspended load and wash load. Accordingly, watershed conservation is indispensable to decrease the sediment accumulation of these reservoirs. However, because of its fine-grained characteristics of the inflow sediment, it is almost impossible to completely prevent the sediment inflow and accumulation in these reservoirs by watershed conservation measures and Sabo facilities. Therefore, sediment removal works such as dredging works and sediment flushing are also necessary for the sustainable use of these reservoirs."

Dredging works have been implemented in the Senggurh, Wlingi, Lodoyo and the Selorejo dam reservoirs. And sediment flushing has been carried out on the Wlingi and the Lodoyo reservoirs since August 1990 immediately after the 1990 eruption of Mt. Kelud.

H2.2.6 Necessity of Basin Sabo Plan

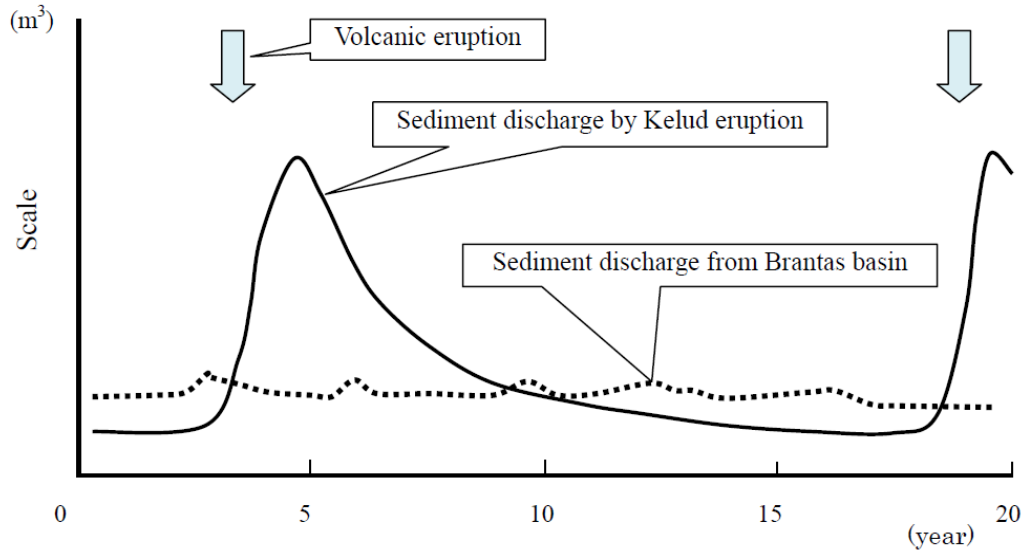
As described above, the basin Sabo plan has been already established in addition to the volcanic Sabo plan against the Brantas River basin. Mt. Kelud erupts every about 15 years, a lot of sediment is supplied into Brantas basin every time. By contrast, the fine-grained sediment is flowed into the Brantas River constantly from the upper area. Therefore, countermeasure which consists of both the volcanic Sabo plan and the basin Sabo plan should be conducted basically.

Figure H2.2.8 shows the image.

The amount of sediment calculated by the Brantas basin Sabo plan and the Kelud volcanic Sabo plan is as shown in Table H2.2.5 before. The total amount of the Brantas basin is estimated to be 114.8 million m^3. Those of the upper Brantas and the upper Lesti are estimated to be approximately 7.6 million m^3 and 5.5 million m^3 respectively. By the way, this amount is not annual discharge but total volume.

The amount of unstable sediment due to volcanic production (volcanic ash and pyroclastic flow), which is estimated to be 105.3 million m^3 as one-time-only eruption, is almost the same amount estimated by the Brantas basin Sabo plan. In fact, considering the long-term plan until 2050, there will be a few eruptions.

Anyway, it is important to carry out the basin Sabo plan in parallel with the Kelud Sabo plan.



Source: JICA Project Team 2

Figure H2.2.8 Image of Sediment Discharge in Kelud Eruption and Brantas Basin

H2.3 Study for Dam Sedimentation by Climate Change

H2.3.1 Basic Concept

i) As mentioned above, sediment deposited in dam reservoirs is dominated by fine-grained silt and clay. And, it is almost impossible to completely control sediment inflow and accumulation in these reservoirs by Sabo facilities. Therefore, another measure which differs from Sabo facilities should be studied to prevent sediment inflow into the dam reservoir. This issue is not only a future issue about the climate change but also the present one.

ii) To prolong the lifetime of the Sutami dam operation is judged to be the most important issue. Therefore, the main aim of this project is to study about control of the fine-grained sediment from the upper stream area of the Senggurh dam.

iii) The volcanic eruption is excluded from this project. Therefore, sediment management associated with the volcanic eruption is excluded from this project.

H2.3.2 About Sediment Inflow into the Dam Reservoir

(1) Sediment Inflow under the Present Climate

Sediment inflow into the dam reservoirs under the present climate and the surface erosion rate calculated by them are as shown in Table H2.3.1.

(2) Sediment Inflow under the Future Climate

Increase ratio of sediment inflow under the future climate (2050), which is calculated based on the change of I (maximum hourly rainfall in a series of rainfall) of the formula USLE, is as shown in Table H2.3.2. According to this table, increase ratio is expected to be average 15% against the dam reservoirs.

On the other hand, according to Table H2.3.1, sediment inflow into the Senggurh dam is expected to be 4.95 million m^3 per year. Therefore, that of 2050 is expected to be 5.69 million m^3 per year more than 15% compare with that under the present climate (2000).

Table H2.3.1 Estimated Sediment Inflow at the Respective Dams

Dam Name	Area (km^2)	Estimated Sediment Inflow* (10^6 m^3/year)	Specific Discharge of Sediment* (m^3/km^2/year)	Surface Erosion Rate (mm/year)	Interval		
Sengguruh	1,659.0	4.950	2,984	2.98	1,988	-	2,012
Sutami	2,050.0	4.390	2,141	2.14	1,989	-	2,012
Wlingi	2,890.0	4.170	1,443	1.44	1,995	-	2,012
Lodoyo	3,017.0	3.710	1,230	1.23	1,996	-	2,012
Wonorejo	126.3	0.520	4,117	4.12	2,004	-	2,012
Selorejo	236.0	0.700	2,966	2.97	1,970	-	2,011
Mean (1-6)	1,663.1	3.073	2,480	2.48			

*: Average
Source: JICA Project Team 2

Table H2.3.2 Rate of Increase of Sediment

(Average)

Scenario	Whole Basin	6 Dams*
Lower (2050/2000)	1.19	1.09
Medium (2050/2000)	1.12	1.12
Upper (2050/2000)	1.33	1.24
Average	1.21	1.15

*: Senggurh, Sutami, Wlingi, Lodoyo, Selorejo, Wonorejo
Source: JICA Project Team 2

H2.3.3 About Source of Sediment Discharge

The Senggurh dam is responsible for the upstream area of the Brantas River and the Lesti River basin. The upstream area of the Brantas River is composed of cultivated land and forest in northeastern area. According to the reconnaissance in the northern area, sediment discharge from cultivated land is concerned. As shown in Figure H2.3.1, the extensive carrot fields have a condition which surface soil is likely to outflow.

Carrot fields cultivated every year

Trenches function as channel

Source: JICA Project Team 2

Figure H2.3.1 Extensive Carrot Field (21/05/2014)

On the other hand, Lest River runs along the western foot of Mt. Semeru. The Aran-Aran River which is tributary of the Lesti River is presumed to include a lot of sediment from reconnaissance and satellite photos. As mentioned in Section H2.2.1 above, the influence of ash deposits on the Lesti River is judged to be small.

But, this project takes the opposite point of view. Namely, the characteristics of the Lesti

River are explained as follows;

The Lesti River originates from the northern slope of Mt. Semeru. Pyroclastic flow occurs frequently in the southern slope of Mt. Semeru. Since the Lesti River basin is located on the western slope of Mt. Semeru, the Lesti River basin is presumed to be partly influenced by ash fall which is composed of fine material.

Specifically, the most upstream of the Aran-Aran River is located at the zone which is directly influenced by ash deposits and ash fall from Mt. Semeru. Therefore, the impact on the Aran-Aran River by the volcanic production from Mt. Semeru is judged to be significant.

Figure H2.3.2 shows a condition of the color of the River at the time of reconnaissance in 2014 and in 2016. Both of river conditions show muddy color (right brown color). Figure H2.3.3 shows the location of the most upstream of the Aran-Aran River. The location is located at the foot of the top of Mt. Semeru which a lot of sediment from gullies easily flow into the source of the Aran-Aran River as shown in Figure H2.3.3 below. Mt. Semeru, which erupts every approximately 30 minutes, is presumed to supply sediment into the river regularly.

20/05/2014 08/09/2016

Source: JICA Project Team 2

Figure H2.3.2 Aran-Aran River (River Water of Muddy Color)

Source: JICA Project Team 2

Figure H2.3.3 Condition of the Source of Aran-Aran River

Joined by the Aran-Aran River, the Lesti River meets the Grangsel River. Figure H2.3.4 shows the conditions of the Lesti River and the Grangsel River. The color of the Grangsel River is pale green color, but the Lesti River is light brown color. Probably, the Lesti River is assumed to be not a little affected by the Aran-Aran River.

On the other hand, the Lesti River joins the Genteng River father downstream. The river

water near Genteng dam, which is planned in the upstream of the Genteng River, shows pale green color as shown in Figure H2.3.5. From the above, sediment supply from the Genteng River to the Senggurh dam is presumed to be a little.

River Water of Light Brown Color
(Lesti River)

River Water of Pale Green Color
(Grangsel River)

Source: JICA Project Team 2

Figure H2.3.4 Difference of the Color of the River Water (08/09/2016)

Upstream of Proposed Dam Site
(Genteng River: Pale Green Color)

Downstream of Proposed Dam Site
(Genteng River: Pale Green Color)

Source: JICA Project Team 2

Figure H2.3.5 Color of the River Water near Proposed Genteng Dam (08/09/2016)

H2.3.4 Adaptation Measures under Climate Change

(1) Basic Policy

1) Against Unstable sediment

The existing Sabo plan is planned by three (3) stages as mentioned above. This plan targets the long term until 2050 under climate change. The primary role of Sabo plan is to fix unstable sediment. Therefore, the existing plan is desirable to be implemented earlier than scheduled.

2) Against Fine-Grained Sediment

As mentioned in Section H2.2.5, fine-grained sediment (wash load) cannot be captured by Sabo facilities such as Sabo dam or consolidation dam. Therefore, an alternative to those facilities should be studied. But, planting works, hillside works, agro-forestry/terracing works and retaining works should be also conducted as mentioned in Section H2.1.2 (refer to watershed conservation plan). Furthermore, according to an increase of heavy rain by the climate change, additional Sabo facilities are required. An increase of debris flow which is a source of wash load is assumed by heavy rain. Basic policy is just to prevent from movement of unstable sediment and to control deposition of wash load against the dam reservoirs.

Accordingly, the following 4 countermeasures, which are partly overlapped here, are proposed as follows;

i) Use of coagulant against fine - grained sediment (a new proposal)
ii) Sand pocket for dredging (combination with i))
iii) Sediment outflow by a diversion tunnel (a new proposal)
iv) Watershed conservation (practice of an integrated Sabo plan)

(2) Adaptation Measures

1) Use of coagulant against fine –grained sediment

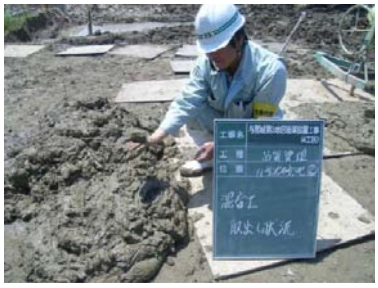
Recycle against fine-grained sediment in the dam reservoir is effective measure. At present, sediment dredged in the reservoir is accumulated on the spoil bank around the reservoir. But, it is a big problem to secure the spoil bank at the same time. Accordingly, effective utilization is more and more expected.

In Japan, as a measure against fine-grained sediment from cultivated land, an experimental trial has been recently conducted to make them easier usable forms for civil engineering material or agricultural material by mixing clay with coagulant. Putting sediment solidified by coagulant back into cultivated land is considerably expected to be effective recycle. An experimental trial for practical use in Brantas basin is desired to solve this problem.

Figure H2.3.6 shows an improvement example by coagulant.

Sample like Sludge

Agitation by Backhoe



Gradually begin to coagulate

Completely coagulated Condition

Source: http://www.pref.okinawa.lg.jp/site/kankyo/hozen/mizu_tsuchi/redclay/info/h27kouryuusyuukai_yokousyuu.html

Figure H2.3.6 Measure using Coagulant

2) Sand Pocket for Dredging

Sand pocket is better to be constructed in the gentle slope. Figure H2.3.7 shows examples of sand pocket. Photo A is an example of a small scale. Photo B is an example of sand pocket which was set at Kont River in northwestern of Mt. Kelud. Role of sand pocket is to capture a great amount of sediment temporarily. It is important to dredge regularly for maintenance

the function. So, as mentioned above, dredging using coagulant is expected for effective recycle.

Dredging is able to be conducted at existing whole Sabo facilities. But, first of all, it is desired to be done at Sabo facilities in the gentle slope of the upstream area of Senggurh dam.

Example of Japan (A)

Example of Kont River (B)

Source: JICA Project Team 2

Figure H2.3.7 Example of Sand Pocket

3) Sediment discharge by a diversion tunnel

This plan is a new measure which makes sediment flow into the Indian Ocean using a diversion tunnel. A hilly terrain around 600m high spreads in the southern area of the Brantas River basin. Therefore, a diversion tunnel has to be constructed under the hilly terrain. And a great amount of the fine-grained sediment included in the Lesti River is presumed to flow into the Indian Ocean. This plan is explained in the following section.

4) Watershed Conservation

As mentioned in “Introduction”, the factor of sediment discharge is presumed to be mainly surface erosion, riverbank/riverbed erosion, slope failure and watershed development such as deforestation and extension of cultivated lands.

The former is natural phenomenon. Therefore, prevention is mainly the structural measure such as Sabo facilities. But the latter has a possibility of the artificial factor. Therefore, it is important that restriction of the development and the development considering the prevention of surface soil erosion should be conducted (refer to Table H2.1.2).

Specifically, they are proper preservation and management against a forest or cultivated land. Sabo facilities are structural measures but these operations are non-structural measures.

Proper preservation and management against a forest mean a multiple-layered forest and Agro-forestry. Specifically, management against forest floor is one of the indispensable managements to prevent surface soil erosion.

Proper development of cultivated land is to make terraces with reverse slope, which calls “Terracing”, to prevent surface soil outflow. And it is important to cover the bare ground by dead grass or something to prevent from raindrop erosion. Proper example could be observed in the inspection of this project (Figure H2.3.8 and Figure H2.3.9).

Cassava & Undergrowth

Forest & Cultivated Land

Source: JICA Project Team 2

Figure H2.3.8 Example of Proper Agro-Forestry (Hillside of Mt. Wilis; 23/05/2014)

Terracing with Reverse Slope

Bare Ground covered by Dead Grass

Source: JICA Project Team 2

Figure H2.3.9 Example of Proper Development (the same as above; 23/05/2014)

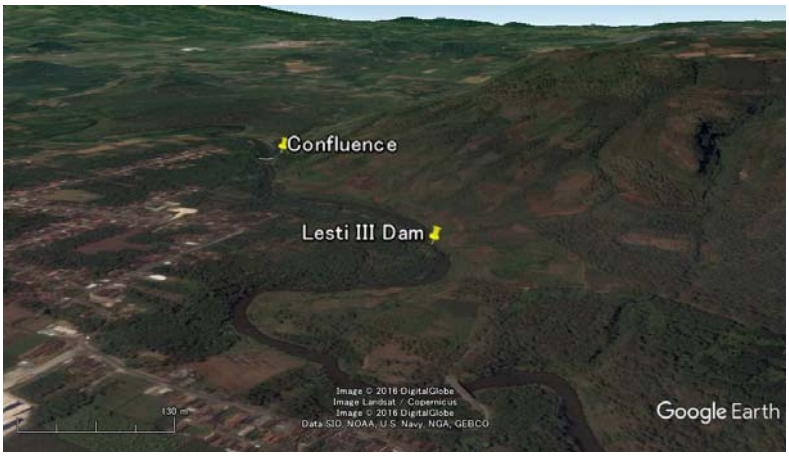
H2.3.5 Diversion Tunnel for Sediment Outflow

(1) Location of Dam

It is extremely difficult topographically to discharge fine-grained sediment directly into the Indian Ocean from the Aran-Aran River. Considering the topographical condition, it is possible to discharge them from the main stream of the Lesti River after joining the Genteng River. At present, Lesti III Dam, which is a multipurpose dam, has been planned at the downstream of the confluence (refer to Figure H2.3.10). At planned dam site, there is a slope on the left bank of the river. On the right bank, there is a terrace whose relative height is approximately ten and several meters. Figure H2.3.11 shows the topographical condition around the Lesti III dam.

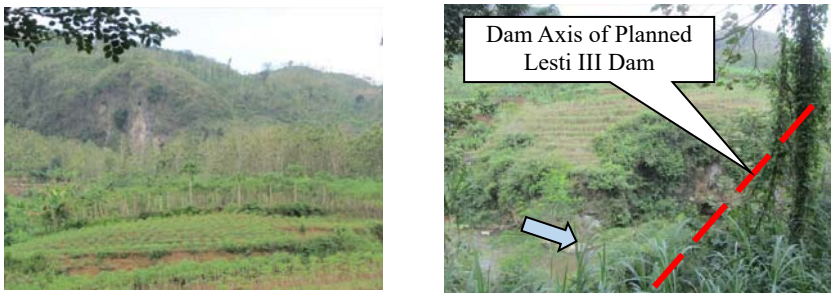
(2) Comparison of Diversion Tunnel Plan

There are two rivers in the Indian Ocean side as the shortest distance. So, two plans are studied here as shown in Table H2.3.3. Location of each plan is shown as in Figure H2.3.12. Each condition is shown as in Figure H2.3.13.



Source: JICA Project Team 2

Figure H2.3.10 Planned Location of Lesti III Dam



Source: JICA Project Team 2

Figure H2.3.11 Topographical Condition of Lesti III Dam Site (08/09/2016)

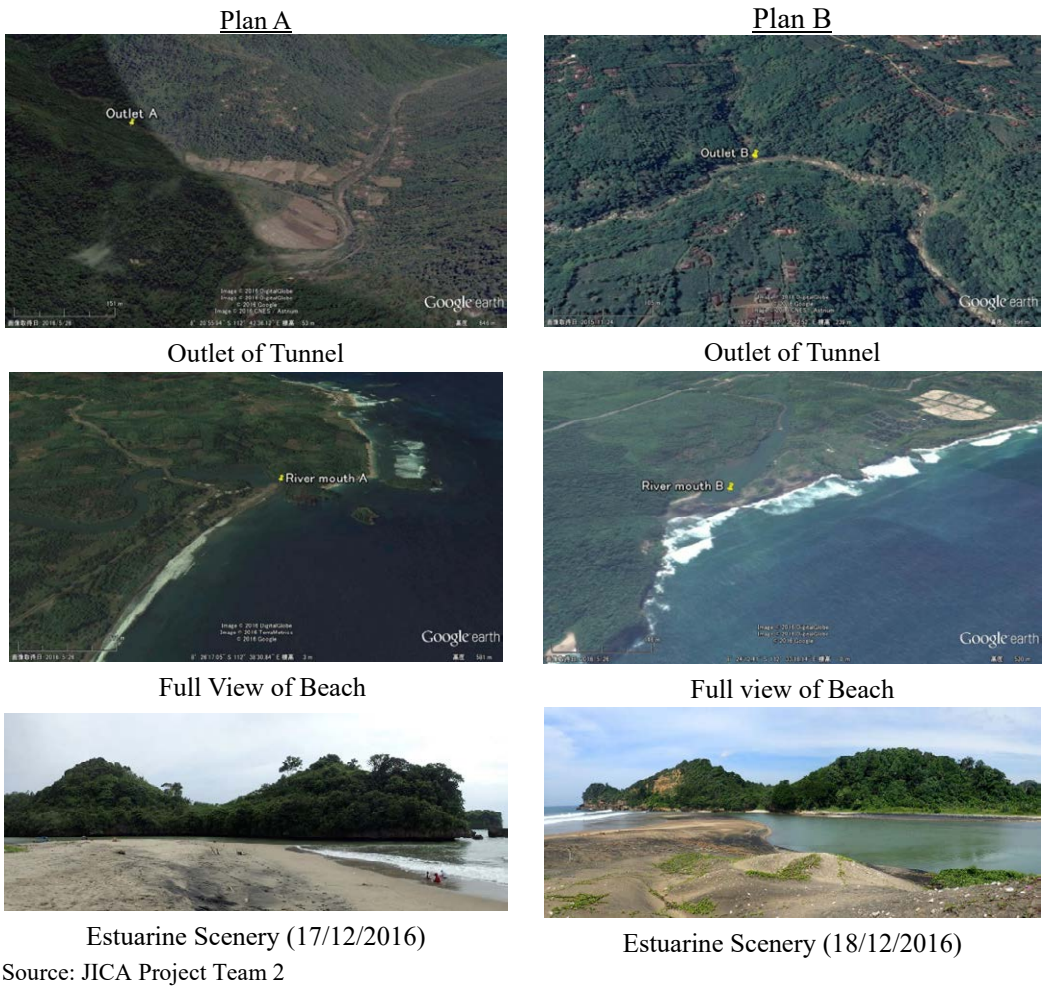
Table H2.3.3 Plans of Diversion Tunnel

Item	Plan A	Plan B
Elevation of outlet	94m	229m
Length	12800m	13400m
Gradient of diversion tunnel	(336 – 94)/12800=0.0189 (1.9%)	(336 – 229)/13400=0.008 (0.8%)
River condition of outlet side	Meanderings are relatively remarkable	Sediment deposition is relatively observed
Sea coast condition	Fine beach	Beach with negative image
Comprehensive evaluation	• Sedimentation in the meandering section is concerned. • Environmental impact by sedimentation around the beach is concerned. • It is possible to discharge fine –grained sediment into the Indian Ocean.	• Environmental impact is thought to be small • Additional sediment deposition is concerned • It is difficult to discharge fine –grained sediment into the Indian Ocean by insufficient gradient

Source: JICA Project Team 2

Source: JICA Project Team 2

Figure H2.3.12 Location of Studied Tunnel



Source: JICA Project Team 2

Figure H2.3.13 Difference of Plan A and B

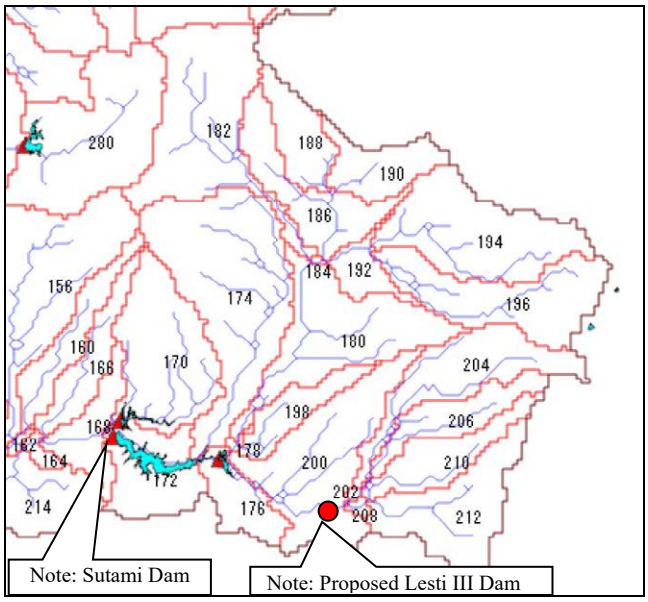
As shown in Table H2.3.3 above, gradient of diversion tunnel of plan A is about 2% which is thought to be possible to discharge sediment. But, because the sea coast is fine coast, environmental consideration is required against sediment discharge. On the other hand,

environmental risk against plan B is judged to be small compared with plan A. But, its gradient, which is 0.8%, is small. But in Japan, diversion tunnel which gradient is 1.0% is operated at present (refer to Table H2.3.4). So, it is presumed that operation of plan B is possible. Therefore, the study of water volume discharged from the Lesti III dam about Plan B is required.

(3) Scale of Diversion Tunnel

1) Sediment discharge from the upstream of the Lesti River

According to the result of study of this project, sediment production from the Upper Brantas (ws182: A=212.0 km^2) and the Upper Lesti (ws204: A=120.5km^2) is presumed to be made up of the majority of that from the upstream of the Senggurh dam. Figure H2.3.14 shows area of the small basin. If most of sediment production in the Brantas basin consists of that from the both basins, sediment discharge from the upstream of the Senggurh dam is distributed as follows.



WS	Area(km^2)	Notes
ws212	129	L III
ws210	70	L III
ws208	4.25	L III
ws206	66.25	L III
ws204	120.5	L III (Upper Lesti)
ws202	2.5	L III
ws200	178	
ws198	50.25	
ws196	145.5	
ws194	170.75	
ws192	34.5	
ws190	64.5	
ws188	60.75	
ws186	100.25	
ws184	1.25	
ws182	212	Upper Brantas
ws180	168.25	
ws178	3.5	
ws176	55.25	
ws174	264.25	
Total	1901.5	

Source: JICA Project Team 2

Figure H2.3.14 Small Basin of the upstream of the Senggurh Dam

Sediment discharge from the upstream of the Senggurh dam under the future climate (2050) is estimated at 5.690×10^{6}m^3/year (refer to Section3.2 (2)). Therefore, amount of sediment discharge (V) from the upstream of the Lesti III Dam and its ratio (R) is estimated as follows;

V=5.690×10^6×120.5/ (212.0+120.5) =2.06×10^{6}m^3/year

R=2.06×10^6/ 5.690×10^6 =0.362 (36.2%)

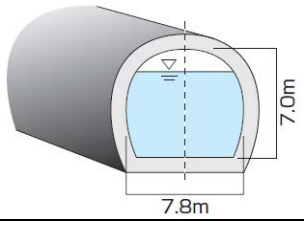
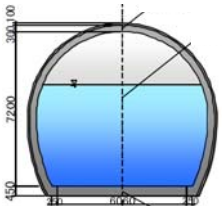
Mix rate of sediment in the wet season and in the flood time is presumed to be higher rate than that in the dry season.

2) Example of Japan

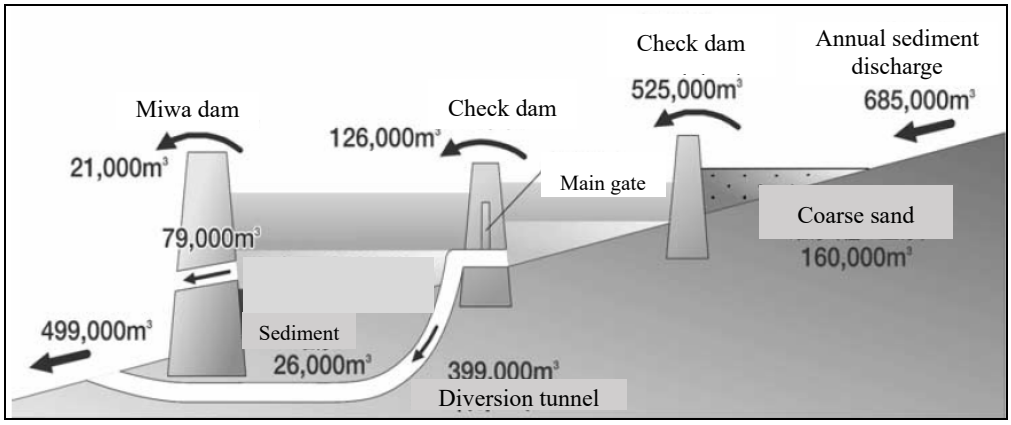
In Japan, sediment deposition in the reservoirs of dams without scouring gate which were

constructed in the 1950s -1960s has become a big problem. Therefore, the study of sediment outflow is proceeding against that kind of dams. Table H2.3.4 shows examples of diversion tunnel for sand elimination in Japan. Figure H2.3.15 shows allocation of sediment outflow of Miwa dam.

Table H2.3.4 Example of Diversion Tunnel in Japan

Item	Miwa Dam	Koshibu Dam
Construction year	1959	1969
Dam form	Gravity-type	Arch-type
Height	69.1m	105.0m
Maximal inflow	1200 m^3/s	1,500 m^3/s
Designed outflow discharge	300 m^3/s	500 m^3/s
Reservoir capacity	29,952,000 m^3	58,000,000 m^3
Designed sediment capacity	6,600,000 m^3	20,000,000
Amount of average annual sediment inflow	685,000 m^3/year	496,000 m^3/year
Amount of sediment	20,000,000 m^3 (2002)	17,512,000 m^3 (2013)
	Diversion tunnel	Diversion tunnel
Construction year	2005	2016
Length	4,308m	3,984m
Designed outflow discharge	300 m^3/s	370 m^3/s
Outflow ratio in flooding	70% (2006)	-
Gradient	1.0%	2.0%
Shape of cross section	Horseshoe section H: 7.0m W: 7.8m 	Horseshoe section H: 7.2m W: 6.06m 

Source: http://www.cbr.mlit.go.jp/mibuso/ (Compiled by JICA Project Team 2)



Source: http://www.cbr.mlit.go.jp/mibuso/

Figure H2.3.15 Allocation of Sediment Outflow of Miwa Dam

3) Construction cost

Approximate cost of diversion tunnel is as in Table H2.3.5.

Table H2.3.5 Approximate Cost of Diversion Tunnel

Item	Figure	Notes
Shape	H: 7.0m W: 8.0m A: about 56m^2	Horseshoe section
Length	12800m	
Total amount of excavation	V=56*12800 =716,800 m^3	
Unit cost (JPY)	35,000 Yen/m^3	Japanese average cost
Unit cost (IDR)	438,970 Rp.	1 JPY=125.42 Rp (19102016)
Total cost (JPY)	Approx. 25.1 billion Yen	=716,800*35,000
Total cost (IDR)	Approx. 314.7 billion Rp.	=716,800*438,970

Source: JICA Project Team 2

CHAPTER H3 ABOUT SEDIMENT DISCHARGE BY CLIMATE CHANGE INFLUENCEIN THE MUSI RIVER BASIN

H3.1 About Amount of the rainfall of Present Climate and Future Climate

The amount of the rainfall of the present climate and the future climate is calculated by three scenarios, i.e. Lower, Medium and High Scenario.

Table H3.1.1 shows the total amount of the rainfall by the scenario of the present climate (Sum 2000: 1985.1.1 - 2000.12.30) and the future climate (Sum 2050: 2050.1.1 - 2065.12.30).

According to Table1.1, the future total amount of the rainfall of the Musi River Basin (Total W/S) is +8 ～-6 % compared to the present climate. In scenario average, increase ratio is +3%.

Table H3.1.1 Total Amount of the Rainfall in the Present and Future

(mm)

	2000	2050	2050/2000
High	863011.5	932239.2	1.08
Medium	861125.6	918116.9	1.07
Low	851656.2	800920.7	0.94
Ave			1.03

Source: JICA Project Team 2

H3.2 Rainfall and Runoff Factor concerning Soil Erosion

The sediment discharge in the future climate is studied by the following method. This method is the same as the method of the Brantas River Basin

The change of the sediment discharge in the future climate is studied by the following formula (USLE: Universal Soil Loss Equation) which is applied about surface soil erosion.

USLE is shown as follows;

$A=R \cdot K \cdot LS \cdot P \cdot C$ (t/ha/year)

where,

A：amount of average annual soil loss

R：rainfall and runoff factor

K：soil erodibility factor

LS：slope length-gradient factor

P：support practice factor

C：crop/vegetation and management factor

R is represented as follows;

$$R = (E \times I_{60}) / 100$$

E is defined to be the amount of the rainfall energy of a series of rainfall.

$$E = (210 + 89LogI) \times r$$

I：maximum hourly rainfall in a series of rainfall (cm/hour)

r：total amount of a continuous rainfall (cm)

In the Musi River Basin, there is no data concerning hourly rainfall. Therefore, "I" was set the same "50% of a daily rainfall" as Brantas River Basin. "R" can calculate using the daily rainfall of the present climate (the calculation term: 01.Jan. 1985 – 30.Dec. 2000) and that of the future climate (the calculation term: 01.Jan. 2050 – 30. Dec. 2065). Also, the other factors except the rainfall factor in the future climate are supposed to be the same as the present ones. The results are as shown Table H3.2.1.

"R" (rainfall and runoff factor) ratio in the Musi Basin is expected an average increase of 15%. This increase is assumed to be caused by increase of hourly rainfall under the future climate. Table H3.2.2 show the detail results.

Table H3.2.1 Increase Ratios of "R" about Musi River Basin

High (2050/2000)	1.37
Medium (2050/2000)	1.11
Low (2050/2000)	0.98
Ave	1.15

Source: JICA Project Team 2

Table H3.2.2 The Rainfall and Runoff Ratio of the Musi Basin

Basin ID	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		1-19
BasinName:	SE	KO1	LE1	MU1	MU2	RA1	OG1	KO2	OG2	MU8	LE2	MU6	HA	RA2	MU5	MU4	LA1	KE	MU3	MU7	Musi Whole	Ave
2000 H Sum	9048.2	4541.5	5519.7	8101.5	13614.9	10739.1	4386.7	9819.6	5270.6	31614.1	3783.3	4676.0	8738.8	10010.1	4560.4	5294.7	5809.9	6845.7	9030.4	9946.8	4194.8	
2000 M Sum	6316.8	8537.9	9051.8	9397.6	9984.6	6766.5	7429.8	6721.0	5809.0	7682.4	4943.4	4812.9	5940.5	7426.8	5577.7	9039.5	7699.2	7337.6	8068.1	5424.1	4489.8	
2000 L Sum	6183.6	12533.5	5148.6	5011.7	8219.1	3990.0	8822.7	7779.2	4871.4	8455.3	4746.5	3890.7	3812.2	4162.2	3968.9	4815.9	4607.9	4929.9	6137.6	4352.9	4579.5	
2050 H Sum	11502.2	5228.3	6388.5	10612.7	17978.2	13995.4	5227.6	12612.5	6989.3	59731.1	4493.7	8783.8	12948.8	13083.4	7019.2	6493.0	6781.7	8438.0	11670.0	18591.5	5165.1	
2050 M Sum	6995.9	9743.1	10434.5	10328.4	10690.9	7761.5	8509.1	7383.2	6358.8	8311.3	5644.1	5210.7	6547.1	8400.9	6199.6	10099.6	8788.6	8389.9	8932.6	5806.5	5102.0	
2050 L Sum	6176.6	13058.9	4958.7	4899.2	8554.3	3716.0	8694.3	7479.1	4965.9	7770.5	4762.6	3858.3	3649.0	3898.0	3790.2	4524.5	4339.6	4718.9	6130.4	4336.0	4355.0	
High (2050/2000)	1.27	1.15	1.16	1.31	1.32	1.30	1.19	1.28	1.33	1.89	1.19	1.88	1.48	1.31	1.54	1.23	1.17	1.23	1.29	1.87	1.23	1.37
Medium (2050/2000)	1.11	1.14	1.15	1.10	1.07	1.15	1.15	1.10	1.09	1.08	1.14	1.08	1.10	1.13	1.11	1.12	1.14	1.14	1.11	1.07	1.14	1.11
Low (2050/2000)	1.00	1.04	0.96	0.98	1.04	0.93	0.99	0.96	1.02	0.92	1.00	0.99	0.96	0.94	0.95	0.94	0.94	0.96	1.00	1.00	0.95	0.98
Ave	1.13	1.11	1.09	1.13	1.14	1.13	1.11	1.11	1.15	1.30	1.11	1.32	1.18	1.12	1.20	1.09	1.08	1.11	1.13	1.31	1.11	1.15

Source: JICA Project Team 2

Supporting Report I

WETLAND MANAGEMENT AND WATERSHED CONSERVATION

Abbreviations

	Indonesia	English
BNPB	Badan Nasional Penanggulangan Bencana	National Disaster Management Agency
BOD		Bio-chemical Oxygen Demand
BPBD	Badan Penanggulangan Bencana Daerah	Regional Agency for Disaster Management
BRG	-	The Government established the Peat Recovery Agency
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
KLHK	Kementerian Lingkungan Hidup dan Kehutana	Ministry of Environment and Forestry
LAPAN	Lembaga Penerbangan dan Antariksa Nasional	Indonesian National Institute of Aeronautics and Space
PP	Peraturan Pemerintah	Government regulation
TRGD	Tim Restorasi Gambut Daerah	Provincial Peat Restoration Service

The Republic of Indonesia

THE PROJECT
FOR
ASSESSING AND INTEGRATING CLIMATE CHANGE IMPACTS INTO THE WATER RESOURCES MANAGEMENT PLANS FOR BRANTAS AND MUSI RIVER BASINS
(WATER RESOURCES MANAGEMENT PLAN)

FINAL REPORT

Supporting Report I : WETLAND MANAGEMENT AND WATERSHED CONSERVATION

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PART 1 BRANTAS RIVER BASIN

CHAPTER I1 INFORMATION COLLECTION CONCERNING WATERSHED CONSERVATION FOR BRANTAS RIVER BASIN

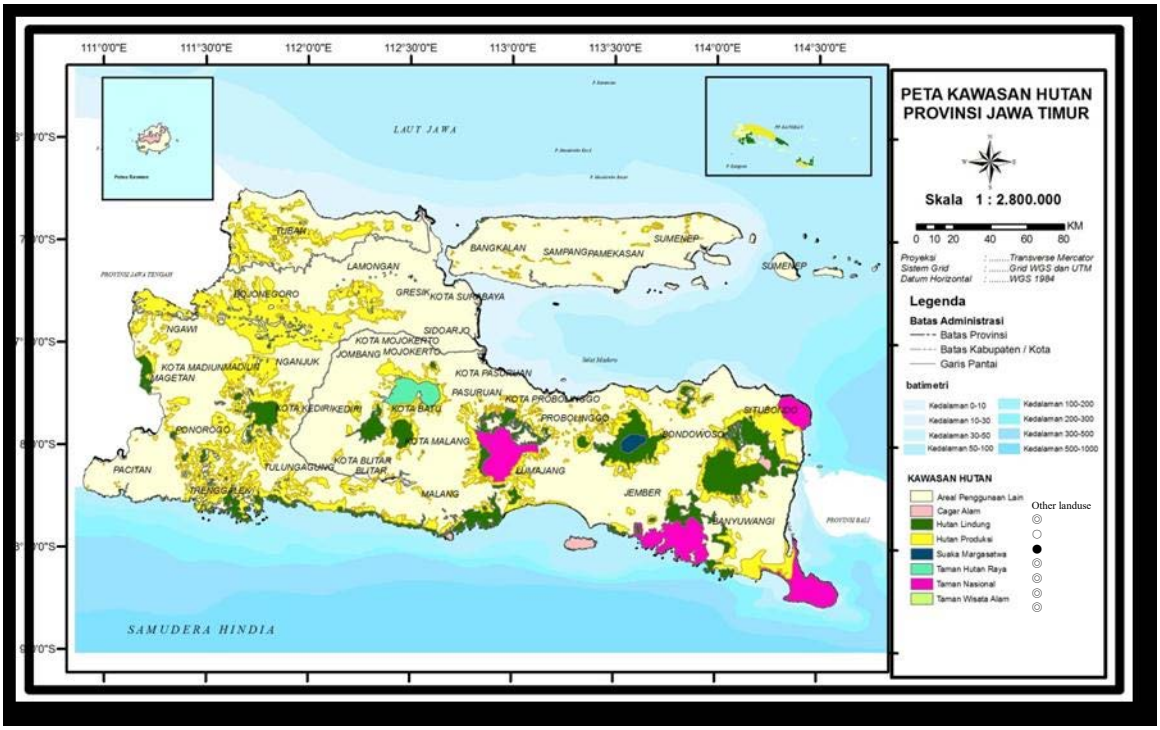
I1.1 Basic Information of Brantas River Basin

I1.1.1 Natural Environment

Following information is summarized through interview survey and collection of secondary information from BBWS Brantas, Center for watershed management (Balai Pengelolaan Daerah Aliran Sungai: BPDAS), natural resources conservation agency (Balai Konservasi Sumer Daya Alam: BKSDA), national park office, provincial environmental office and NGOs.

(a) Forest

Recorded forestland is 520,498.7ha (2015, Review POLA), among it, production forest is 354,944ha (68.2%), protection forest is 113,918ha (21.9%), and conservation forest is 51,582ha (9.9%). Nine forest management units (Kesatuan Pemangkuan Hutan: hereinafter called "KPH") are in charge of the management of the forest land, and Malang and Kediri KPH are the biggest among them which manages approximately 120,000ha each. The forest type distribution is shown in Figure I1.1.1.



Note: ◎: Conservation forest, ○: Protection forest, ●: Production forest
Source: Forest Department, East Java Province

Figure I1.1.1 Forestland in East Java Province

(b) Protected area

Bromo Tengger Semeru National Park is overlapping with Brantas watershed. No wildlife reserve (Suaka Margasatwa) is located in the watershed, while three nature reserves (Cagar Alam) is set in Besowo Gadungan, Manggis Gadungan and Gunung Abang. Five of IBA (Important Bird Area) are located in the watershed.

(c) Ecosystem

The watershed is in East Java Ecoregion, where tropical rainforest vegetation and 103 species of mammal are recorded. As endemic species, followings are important to be protected, or Javan Warty Pig (*Sus verrucosus*, endangered/EN), Yellow-throated Marten (*Martes flavigula robinsoni*, least concern/LC), Banteng (*Bos javanicus*, endangered/EN) and Javan Leopard (*Panthera pardus melas*, critically endangered/CR). Cave nectar bat (*Eonycteris spelaea*) is important for the ecosystem for distributing and dispersing pollen and seeds.

In river systems, following large fish species are recorded, or *Hemibragus nemurus* (a kind of catfish), *Channa striatus* (a kind of snakehead).

(d) Landscape

Gunung Baung nature tourism park (Taman Wisata Alam) and Tretes nature tourism park are designated. Batu area is famous in Indonesia as a tourist destination.

I1.1.2 Water Quality

Water quality test is regularly conducted every year. Tables I1.1.1 shows the example of the monitoring result of the water quality of Brantas River published in the website of BLH (Environmental Agency) of East Java Province. Table I1.1.2 summarizes the monthly monitoring result in 2012 for each monitoring sections and Table I1.1.3 summarizes the seasonal difference. Table I1.1.4 summarizes annual monitoring result from 2010 to 2014. BOD figures exceed the standard value while COD and DO is in the standard (however, they are not so good value). In the upper and medium stream, the water quality is worst in wet season while dry season is 2nd worst, which is considered to be the effect of impact by water flow in wet season and impact of enrichment effect in dry season. In the lower stream, the water quality is worse when drier, which is considered to be the effect of enrichment effect.

In Surabaya River, mass death of fish is reported in 2012 due to the pollution from sugar industry. DO in the downstream of Brantas River and other branch rivers are low, and it is expected that some spots may have lower figure which can harm fish instantly.

Table I1.1.1 Monitoring Result of Water Quality of Brantas River in July 2012 (Example)

Section	NO.	Location	Coordinate		BOD5	COD	DO
					mg/l	mg/l	mg/l
Upper	1.	Jembatan Pendem	S 07°54'10.5"	E 112°34'27.9"	4	9	8,91
	2.	Jembatan Dinoyo	S 07°56'22.4"	E 112°36'42.9"	2	6,1	8,51
	3.	Jembatan Gadang	S 08°01'28.0"	E 112°37'58.4"	2,1	7,7	7,59
	4.	Jembatan Senggruh	S 08°10'55.5"	E 112°32'47.7"	2,2	6,4	7,93
	5.	Jembatan Kali Pare	S 08°09'23.6"	E 112°26'03.6"	2	5,8	7,19
	6.	Jembatan Kademangan	S 08°08'23.3"	E 112°08'47.4"	4,4	11,8	9,61
	Average of Upper Section				**2,78**	**7,80**	**8,29**
Medium	1.	Jembatan Ngujang	S 08°00'59.5"	E 111°55'31.3"	4,2	12,2	9,51
	2.	Jembatan Meritjan	S 07°46'56.5"	E 112°00'31.0"	5,2	13,4	7,69
	3.	Jembatan Kertosono	S 07°36'01.4"	E 112°06'31.5"	2,2	7,7	7,32
	4.	Jembatan Ploso	S 07°27'39.3"	E 112°13'28.2"	2,3	7,4	8,17
	5.	Jembatan Padangan	S 07°27'33.1"	E 112°25'55.5"	3,5	9	9,78
	Average of Medium Section				**3,48**	**9,94**	**8,49**
Low	1.	Jembatan Canggu	S 07°25'39.6"	E 112°28'25.1"	3	6,1	7,49
	2.	Jembatan Perning	S 07°24'30.2"	E 112°29'34.2"	4,6	12,2	7,29
	3.	Jembatan Legundi	S 07°23'13.3"	E 112°34'37.7"	2,1	5,9	6,88
	4.	Tambangan Cangkir	S 07°21'56.6"	E 112°37'57.6"	3,1	7,4	5,26
	5.	Tambangan Bambe	S 07°21'03,5"	E 112°39'44,6"	2	6,1	6,07
	6.	Jemb. Karangpilang (Sebelum Intake PDAM)	S 07°20'53.0"	E 112°40'51.3"	4,5	12,2	3,77
	7.	Jembatan Sepanjang	S 07°20'36.0"	E 112°41'42.6"	4,8	11,5	3,5
	8.	Bendungan Gunungsari	S 07°18'29.1"	E 112°43'10.7"	6,3	13	3,3
	Average of Low Section				**3,80**	**9,30**	**5,45**

Source: BLH East Java Province

Table I1.1.2 Monthly Monitoring Result of Water Quality of Brantas River in 2012

	Section	Upper	Medium	Down	Upper	Medium	Down	Upper	Medium	Down
Month	Season	BOD	BOD	BOD	COD	COD	COD	DO	DO	DO
January	Wet	2.91	3.35	5.29	11.09	8.83	12.92	8.01	7.62	5.86
February	Wet	2.99	2.72	3.62	8.54	6.78	10.06	7.77	7.67	5.79
March	Wet	4.97	3.74	4.15	12.38	9.44	10.7	7.42	7.35	5.49
April	Med-wet	3.2	3.94	3.66	7.67	9.4	7.89	7.92	8.13	5.11
May	Med-wet	2.75	3.02	4.43	6.88	9.6	11.66	7.37	7.68	5.98
June	Dry	2.98	3.86	5.61	11.07	10.76	15.36	7.63	7.5	5.27
July	Dry	2.78	3.48	3.8	7.8	9.94	9.3	8.29	8.49	5.45
August	Dry	3.79	3.64	2.98	7.88	8.38	7.55	8.77	8.42	5.57
September	Dry	3.21	2.83	3.58	6.87	6.7	8.77	8.23	8.26	4.93
October	Dry	3.48	3.26	3.59	8.76	8.58	9.56	7.24	7.78	6.25
November	Wet	4.46	3.44	3.26	11.36	8.26	6.93	6.37	6.61	5.1
December	Wet	4.42	4.24	4.77	11.09	11.76	11.36	6.8	7.28	4.85
Average		3.50	3.46	4.06	9.28	9.04	10.17	7.65	7.73	5.47
Env. Standard		3	3	3	25	25	25	4	4	4

Source: Calculation based on the data from BLH East Java Province

Table I1.1.3 Seasonal Monitoring Result of Water Quality of Brantas River in 2012

	BOD (mg/l)			COD (mg/l)			DO (mg/l)		
	Upper	**Medium**	**Down**	**Upper**	**Medium**	**Down**	**Upper**	**Medium**	**Down**
Wet	3.95	3.50	4.22	10.89	9.01	10.39	7.27	7.31	5.42
Med-Wet	2.98	3.48	4.05	7.28	9.50	9.78	7.65	7.91	5.55
Dry	3.25	3.41	3.91	8.48	8.87	10.11	8.03	8.09	5.49

Note: Wet: November to March, Medium-wet: April to May, and Dry: June to October
Source: Calculation based on the data from BLH East Java Province

Table I1.1.4 Annual Monitoring Result of Water Quality of Brantas River in 2010-2014

	Unit	**2010**	**2011**	**2012**	**2013**	**2014**	**Average**	**Env. Standard**
BOD	mg/l	5.12	4.41	4.33	3.60	4.27	4.35	3.00
COD	mg/l	17.94	15.45	13.64	10.92	12.45	14.08	25.00

Source: BLH East Java Province

I1.2 Assessment of Climate Change Impacts in 2050 concerning Watershed Conservation

I1.2.1 Water Demand Projection concerning Maintenance Flow

Article 25 in PP No.38/2011 (Sungai) is referring to maintenance flow. Article 25 is shown below:

Article 25 (Translation to English)

(1) Protection of the flow of the river maintenance as referred to in Article 20 paragraph (3) letter is intended to maintain the river's ecosystem.

(2) Keeping the river ecosystem as referred to in paragraph (1) shall be carried from upstream to the mouth of the river.

(3) Protection of the flow of the river maintenance is done by controlling the availability of debit mainstay of 95% (ninety five percent).

(4) In the case of debit mainstay of 95% (ninety five percent) is not reached, the management of water resources need to control the use of water upstream.

The maintenance flow is set from 95% of the flow regime at the present condition. Even the future condition under the climate change, the maintenance flow is applied to same value at the present condition.

The reference points in the Brantas River are set at Downstream of the Sutami dam, the Mrican barrage and the New Lengkong dam along the mainstream and the major tributaries at just before confluence of the mainstream. Table I1.2.1 shows the maintenance flow at each reference point.

Table I1.2.1 Maintenance Flow

Reference point	**Discharge (m^3/s)**	**Reference point**	**Discharge (m^3/s)**
1. mainstream		**2. Tributary**	
Downstream of Sutami dam	32.30	Tulungagung	12.33
Downstream of Mrican Barrage	54.08	Konto	1.64
Downstream of New Lengkong dam	32.13	Widas	4.38
		Sadar	1.11

Note: Maintenance flow of the tributaries set at just before confluence of the mainstream
Source: JICA Project Team 2

CHAPTER I2 CLIMATE CHANGE ADAPTATION MEASURES FOR WATER RESOURCES MANAGEMENT PLANS OF BRANTAS RIVER BASIN CONCERNING WATERSHED CONSERVATION

I2.1 Identification of Adaptation Measures against Climate Change Impacts concerning Watershed Conservation

I2.1.1 Adaptation Measures against Rainstorms and Floods

(1) Water Quality Management against Heavy Rain

Water quality degradation by the heavier rain should be controlled by reducing soil degradation by sabo measures such as check dams, contour cropping, gabions, agroforestry and so on. These structural adaptation measures are included in Sabo Management.

(2) Water Quality Management against Fertilizer Application

Appropriate application of fertilizer contributes to keeping the discharge of eutrophication substances by the flood.

Water quality degradation during lower water should be controlled by (1) keeping the current lowest water level as well as (2) wastewater treatment

(3) Watershed Conservation

Improving of water retaining capacity in a watershed by the forest cover will contribute to the adaptation measures against rainstorms and floods by reducing surface runoff as well as facilitating the rainwater absorption into the ground.

However, it is noted that forest stands (trees) will worsen the damage in combination with water and soil in case of the strong flush flood and/or landslide.

The priority target areas will be considered from 1) existence of forest areas, 2) upper watershed (with the consideration of settlement directly below), 3) relationship with important aquifers, and 4) critical land area. Considering the future land use, keeping the forest land at the present level is important and the improvement of the quality of the forest is also effective. Since the production forest counts for nearly 70% of the recorded forest land, it is very important that production forest is sustainably managed by the well-planned cycle from plantation to harvest.

Plantation outside these forestlands should also be promoted to increase the forest area without changing land use.

To maximize the adaptation capacity with watershed conservation, it is also necessary to monitor the impact to the vegetation by the climate change such as rainfall pattern change, temperature rise and forest fires.

Prioritization as per forest type is summarized in Table I2.1.1.

Table I2.1.1 Watershed Conservation against Rainstorms and Floods

No.	Forest type	Target Area	Ratio (forest land)	Consideration points for prioritization
1	Conservation forest	51,582ha	9.9%	- Protection - Fire prevention - Monitoring
2	Protection forest	113,918ha	21.9%	- Protection - Conservation work - Fire prevention - Monitoring
3	Production forest	354,944ha	68.2%	- Sustainable management - Fire prevention - Monitoring
4	Outside the recorded forest land	All Brantas River basin	-	- Promotion of plantation in the slopes - Promotion of plantation for fencing for residential area and agriculture area - Promotion of agroforestry - Promotion of green area in the city

Source: JICA Project Team 2, Review POLA 2015 indicates total recorded forest land is 520,498.7ha.

I2.1.2 Adaptation Measures against Droughts

(1) Water Quality Management by Wastewater Treatment

Water quality degradation during lower water can be controlled by promoting wastewater treatment system such as waste water treatment plant, septic tank and *Jokaso*. However, these measures are not climate change adaptation measures but the normal water quality management activities.

(2) Water Quality Management by Water Level

Water quality degradation during lower water should be controlled by keeping the current lowest water level.

Since it is difficult to estimate the water quality change by the flow level change, it is recommended to keep the water level in every existing monitoring points as the current lowest water level. On the other hand, priority points can be identified with the water quality. It is more necessary to keep the water level in the points with lower water quality.

(3) Watershed Conservation

Contribution of watershed conservation effort against droughts are difficult to be evaluated, while the forest cover is regarded to be effective to some extent. Forest cover will help retaining the water resources and stabilize the water discharge from the water source area which mitigate the impact on drought in the lower watershed. Thus, the climate change adaptation measures by watershed conservation is to improve the forest management especially in the upper watershed, which is mostly the same as discussed in I2.1.1.

However, it is also known that the forest cover will negatively contribute to the water resources by evaporation through the breathing of the trees and vegetations.

Green areas can nurture ground water resources by allowing rainfall to be absorbed efficiently especially in the development areas covered by the concrete.

Prioritization as per forest type is summarized in Table I2.1.2.

Table I2.1.2 Watershed Conservation against Droughts

No.	Forest type	Target Area	Ratio (forest land)	Consideration points for prioritization
1	Conservation forest	51,582ha	9.9%	- Protection - Fire prevention - Monitoring
2	Protection forest	113,918ha	21.9%	- Protection - Rehabilitation work - Fire prevention - Monitoring
3	Production forest	354,944ha	68.2%	- Sustainable management - Fire prevention - Monitoring
4	Outside the recorded forest land	All Brantas River basin	-	- Promotion of green area in the city

Source: JICA Project Team 2, Review POLA 2015 indicates total recorded forest land is 520,498.7ha.

I2.2 Priority Actions for Adaptation and Mitigation Measures against Climate Change Impacts concerning Watershed Conservation

I2.2.1 Priority Actions as Climate Change Measures against Rainstorms and Floods

(1) Water Quality Management

As discussed in the I2.1.1, the priority action is controlling the excessive fertilizer application in agriculture. The action is the non-structural measures.

(2) Watershed Conservation

As discussed in the I2.1.1, the priority actions are to maximize the water retaining capacity by the forest cover by keeping the forest cover and improving the quality of forest. The actions are non-structural measures.

Priority actions are summarized in Table I2.2.1.

Table I2.2.1 Priority Actions: Watershed Conservation against Rainstorms and Floods

No.	Priority actions	Detail actions	Target Forest	Consideration points for prioritization
1	Protection of forest	- Protection from illegal felling	- Conservation forest - Protection forest	- Upper watershed - The area where larger rainfall change is expected (especially more rainfall) - The area with higher productive aquifers - Critical area
2	Fire prevention	- Fire prevention works - Preparation for firefighting equipment - Monitoring of hot spots	- Conservation forest - Protection forest - Production forest	- Upper watershed - The area where larger rainfall change is expected (especially less rainfall) - The area where lower ground water level is expected - Critical area
3	Rehabilitation work	- Regeneration improvement works	- Protection forest	- Upper watershed - The area where larger rainfall change is expected (especially more rainfall) - The area with higher productive aquifers - Critical area
4	Sustainable management	- Sustainable forestry practice	- Production forest	- Upper watershed - The area where larger rainfall change is expected (especially more rainfall)

No.	Priority actions	Detail actions	Target Forest	Consideration points for prioritization
				- The area with higher productive aquifers - The area where lower ground water level is expected - Critical area - Large forest concession holder
5	Monitoring	- Monitoring of impact to the ecosystem by climate change	- Conservation forest - Protection forest - Production forest	- The area where rainfall pattern is changed - The area where higher temperature rise is expected - The area where disease or pest attack is recorded - Critical area where soil is degraded by climate change
6	Promotion of plantation outside forest land	- Public information and environmental education - Technical support and seedling production	- Outside forest land	- Upper watershed - The area with the slopes - City area

Source: JICA Project Team 2

I2.2.2 Priority Actions as Climate Change Measures against Droughts

(1) Water Quality Management

As discussed in the I2.1.2, the priority action is keeping the current lowest water level especially in the river system whose water quality is degraded. The action is the non-structural measures.

(2) Watershed Conservation

As discussed in the I2.1.2, the priority actions are to maximize the water retaining capacity by the forest cover by keeping the forest cover and improve the quality of forest. It is also noted that forest cover is generally appreciated for its water retaining capacity, while it may also increase the evaporation by the breath of trees and eventually reduces the available water volume in the watershed.

Priority actions are summarized in Table I2.2.2.

Table I2.2.2 Priority Actions: Watershed Conservation against Droughts

No.	Priority actions	Detail actions	Target Forest	Consideration points for prioritization
1	Protection of forest	- Protection from illegal felling	- Conservation forest - Protection forest	- Upper watershed - The area where larger rainfall change is expected (especially more rainfall) - The area with higher productive aquifers - Critical area
2	Fire prevention	- Fire prevention works - Preparation for firefighting equipment - Monitoring of hot spots	- Conservation forest - Protection forest - Production forest	- Upper watershed - The area where larger rainfall change is expected (especially less rainfall) - The area where lower ground water level is expected - Critical area
3	Rehabilitation work	- Regeneration improvement works	- Protection forest	- Upper watershed - The area where larger rainfall change is expected (especially more rainfall)

No.	Priority actions	Detail actions	Target Forest	Consideration points for prioritization
				- The area with higher productive aquifers - Critical area
4	Sustainable management	- Sustainable forestry practice	- Production forest	- Upper watershed - The area where larger rainfall change is expected (especially more rainfall) - The area with higher productive aquifers - The area where lower ground water level is expected - Critical area - Large forest concession holder
5	Monitoring	- Monitoring of impact to the ecosystem by climate change	- Conservation forest - Protection forest - Production forest	- The area where rainfall pattern is changed - The area where higher temperature rise is expected - The area where disease or pest attack is recorded - Critical area where soil is degraded by climate change
6	Promotion of plantation outside forest land	- Public information and environmental education - Technical support and seedling production	- Outside forest land	- Upper watershed - The area with the slopes - City area

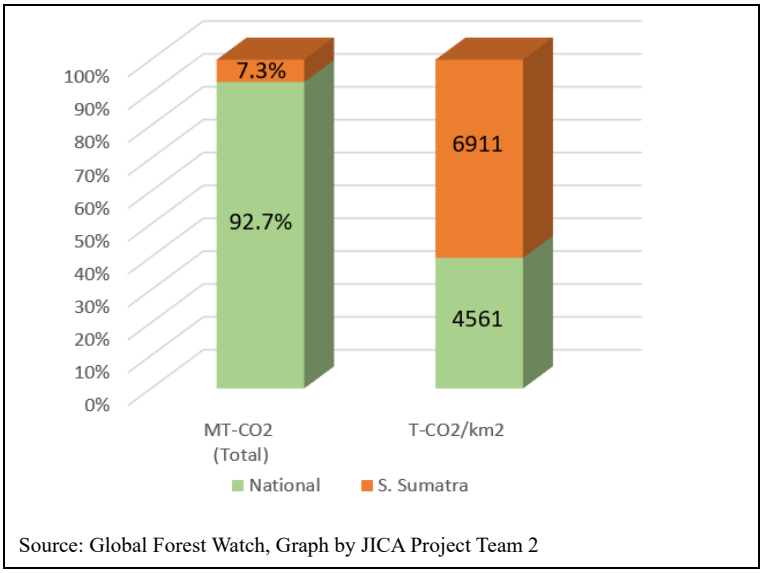
Source: JICA Project Team 2

PART 2 MUSI RIVER BASIN

CHAPTER I3 MITIGATION MEASURES FOR CO_2 FROM PEATLAD

I3.1 CO_2 Emission from Peatland of the South Sumatra

Regarding the reduction of CO_2 as the consent measure to mitigate climate change, the Indonesian government has also indicated a reduction plan in the Paris Agreement in 2015. CO_2 emissions from peatland fires account for a large percentage of Indonesia. Figure I3.1.1 shows 7.3% of CO_2 is emitted in the South Sumatra alone, and the emission of CO_2 per land area is 150% of the national level. The responsibility of the South Sumatra Government for reducing CO_2 is not small. Here, various effort to reduce and suppression of the peatland fires, by the Indonesian government and other organizations are summarized.



Source: Global Forest Watch, Graph by JICA Project Team 2

Figure I3.1.1 CO_2 Emission of S. Sumatra and National (2001-2016)

I3.2 Causes and Processes of Forest Fires

Looking at the current status of CO_2 emissions in South Sumatra, large-scale peatland fires are the primary causes due to human activities. Incineration of forest cover and peat occurs in the process of plantation creation, and climate change is not being the direct cause. The general stages of CO_2 generation in the South Sumatra are as follows.

Phase-1) The government grants the plantation company a forest development permit (concession)

Phase-2) Excavation of the water channel by plantation companies

Phase-3) The target land is dried artificially draining the groundwater through the excavated channels

Phase-4) Set fire and incinerate the forest in the target concession area (fire may spread outside of the concession area accidentally, especially during a dry year)

Phase-5) Land preparation for plantation

Phase-6) The organic matter continues to drain from the waterways.

I3.3 Countermeasures for each Phase of Peatland Firing Process

I3.3.1 Control over Plantation Permit

As a suppressing measure for ever-increasing plantation, the Government has been issuing Government Regulations (PPs). The newest one is the Moratorium of Peatland Use (PP 57/2016). The sequence of issuance of PPs is as followings.

2011 Established development moratorium by President Yudhoyono

2014 Amendment, President Joko Widodo signed PP number 71/2014, supported by General Secretary of the Ministry of Environment and Forestry, Bambang Hendroyono

2016 Amendment, PP 57/2016 December 2, 2016, signed by President Joko Widodo, Ministry of Environment and Forestry (KLHK)

The principle s of PP57/2016 are as follows.

(1) Permanent Ban of the Peatland Use

It is now prohibited to open new land in the conservation area*. Indonesia's peatland is divided into two categories: the conservation areas (12.4 million ha) and the production areas (12.2 million ha). Penalties will be imposed for illegal acts. Although the concession contract has been signed, the forest areas in Protection Function, indicated in green color, are now the subject area to be recovered (Figure I3.3.2). Note some area of IUPHHK-HT, the licensed plantation areas, have changed to protected areas.

* a map of Environment and Forestry Ministry's Environmental Pollution and Damage Control Directorate General

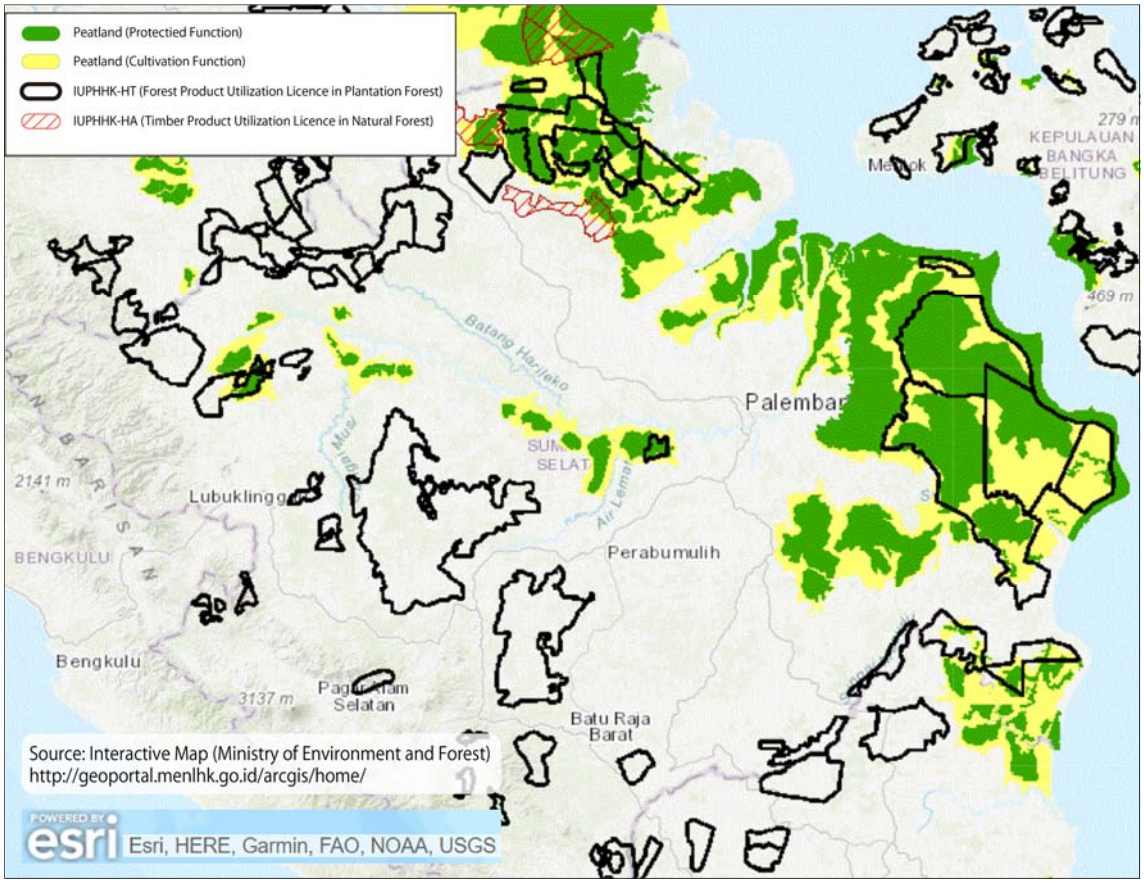


Figure I3.3.2 Classification of Peatland and Concession Area (2019)

(2) Recovery of Peatland

Plantations in peatland that were converted into concessions will be converted back to their original functions in the absence of human intervention. Concession owners are prohibited from planting on areas designated as conservation areas. Except for companies already growing commodities on the conservation areas, the government has allowed them to harvest their commodities only once. The government will not bear the cost of recovery for concessions to corporations. The groundwater level should not be lower than 0.4m below the surface.

(3) Rescue Measures for the Private Company with Concessions

The Government will take over the peatland with private concession under KLHK Regulation No.77, 2015.

These measures, however, have been controversial, and there are cases of legal disputes. Because forests utilization licenses have been legally issued to the plantation project owners, as shown in Table I3.3.1, since 2008.

Table I3.3.1 Types of Forest Utilization Licenses

License Name	Forest Classification	Abbreviation	Former name
Timber Product Utilization License	Natural Forest	IUPHHK-HA	HPH
Forest Product Utilization License	Plantation Forest	IUPHHK-HT	HP-HTI
	Community Plantation Forest	IUPHHK-HTR	-
Timber Product Utilization License	Ecosystem Restoration	IUPHHK-RE	-
	Community Forest	IUPHHK-HKm	-

Source: Government Regulation Number 6/2007 [revised by] Government Regulation Number 3/2008

I3.3.2 Establishment of the Taskforce

Peatland Restoration Agency (Badan Restorasi Gambut Republik Indonesia: BRG) was established on 6 January 2016, based on Presidential Regulation No. 1/2016 as a task force for implementing PP57/2016. BRG's target is to restore approximately two million hectares of degraded peatland within five years period. It's priority Regions are the provinces of Riau, South Sumatra, Jambi, Central Kalimantan, South Kalimantan, West Kalimantan, and Papua.

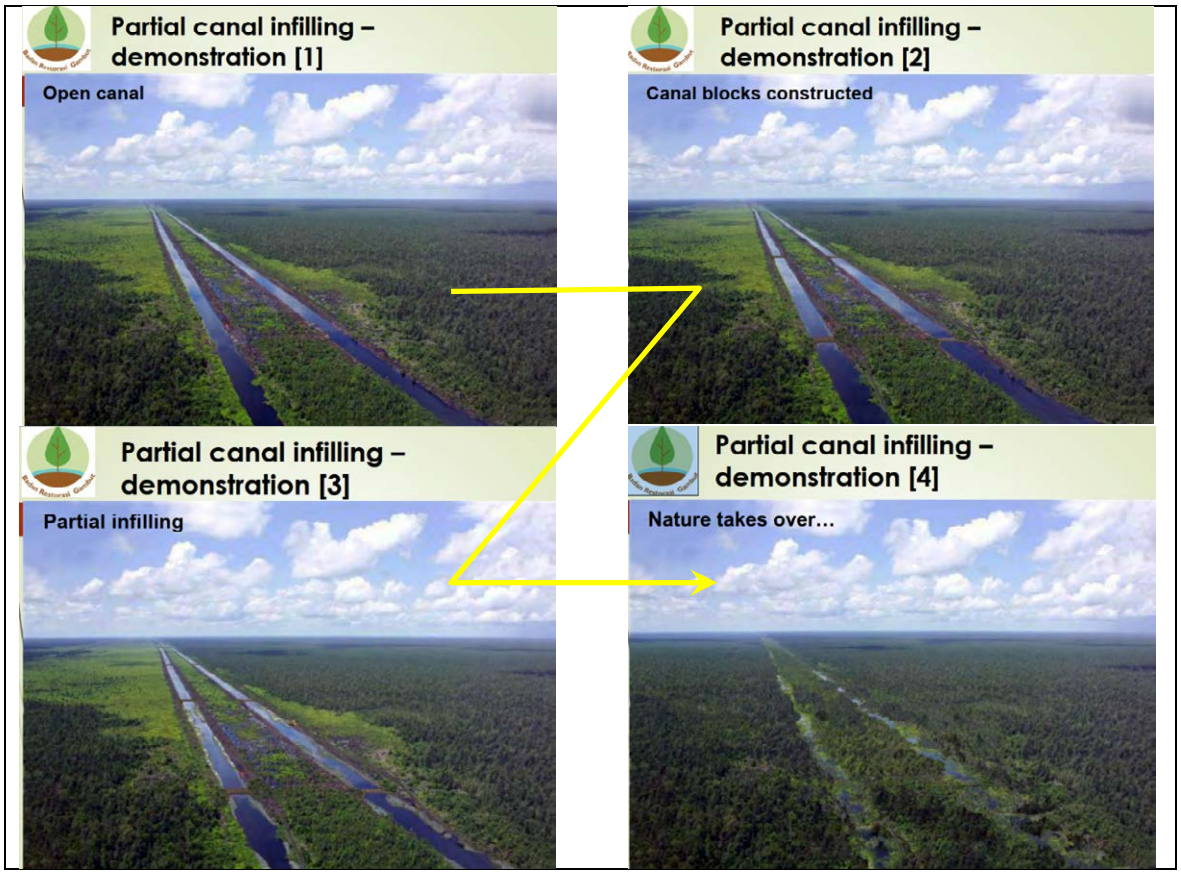
BRG is a non-structural institution placed directly under and responsible to the President. The responsibility of BRG is to coordinate with the Provincial Peatland Restoration Team (Tim Restorasi Gambut Daerah: TRGD) and facilitate the restoration of peatland in priority regions (Table I3.3.2).

Table I3.3.2 Outlines of Provincial Peatland Restoration Team (TRGD)

Provinces	#PHU	PHU Area (hectares)	Peatland area (hectares)	Peat-dome area (hectares)	Non-peat area (hectares)	Restoration priority (hectares)
Riau	49	5,140,000	4,221,000	1,486,780	918,755	938,619
Jambi	10	1,040,000	751,000	298,804	288,669	136,541
South Sumatera	26	2,371,800	1,171,800	690,715	1,183,324	445,749
Sumatera Total	**85**	**8,551,800**	**6,143,800**	**2,476,299**	**2,390,747**	**1,520,909**
West Kalimantan	91	3,040,400	1,840,400	698,653	1,183,917	324,285
Central Kalimantan	32	4,633,000	3,053,000	1,770,940	1,581,809	683,024
South Kalimantan	4	340,814	160,214	93,946	180,561	68,734
Kalimantan Total	**127**	**8,014,214**	**5,053,614**	**2,563,539**	**2,946,286**	**1,076,043**
Papua	226	6,099,500	4,899,500	730,076	1,176,608	82,293
Total 7 Provinces	**438**	**22,665,514**	**16,096,914**	**5,769,914**	**6,513,641**	**2,679,245**

Source: BRG

TRGD in the South Sumatra province is making maps and databases of peat distributed area and the utilization of the peatland. TRGD is also trying to identify illegal water channels and blocking the groundwater being drained. So that the groundwater level will not be lowered and eventually will prevent the forest fire. The channel blocking scheme is shown in Figure I3.3.3.



Source: BRG

Figure I3.3.3 Image of Recovering Peatland by Channel Blockages

I3.3.3 Enforcement of Laws Restricting Burning Peatland Forest

The Ministry of Environment and Forestry (KLHK) is being proactive in prosecution. KLHK is accusing people who caused malicious burning of peatland forest to the court and usually wins the cases against the firms that are responsible for forest burning.

The followings are some examples of the court cases; however, none of the convicted companies have paid the fines or compensation.

- The court ordered a fine of US$35 million for Waringin Agro Jaya.
- The South Jakarta District Court found a palm oil company, PT Waringin Agro Jaya, guilty of started a forest fire in Ogan Komering Ilir, South Sumatra. The court ordered the company to pay Rp. 466.5 billion (US$35 million)
- The Supreme Court ruled in November PT Merbau Pelalawan Lestari guilty of illegally clearing forests in Pelalawan regency, Riau, from 2004 to 2006 and ordered to pay Rp 16 trillion in fines, the highest in any case of environmental destruction in the nation's history.
- PT National Sago Prima was found guilty in August 2016 of illegally starting forest fires in its concession area in Meranti Islands regency, Riau, and ordered to pay Rp 1.07 trillion in fines.
- August in the same year, the Palembang High Court in South Sumatra found pulpwood firm PT Bumi Mekar Hijau guilty of illegally starting fires in its concession in 2014. The

high court had ordered the firm to pay Rp 78.5 billion in damages, a fraction of the Rp 7.8 trillion fine sought by the ministry in 2015.

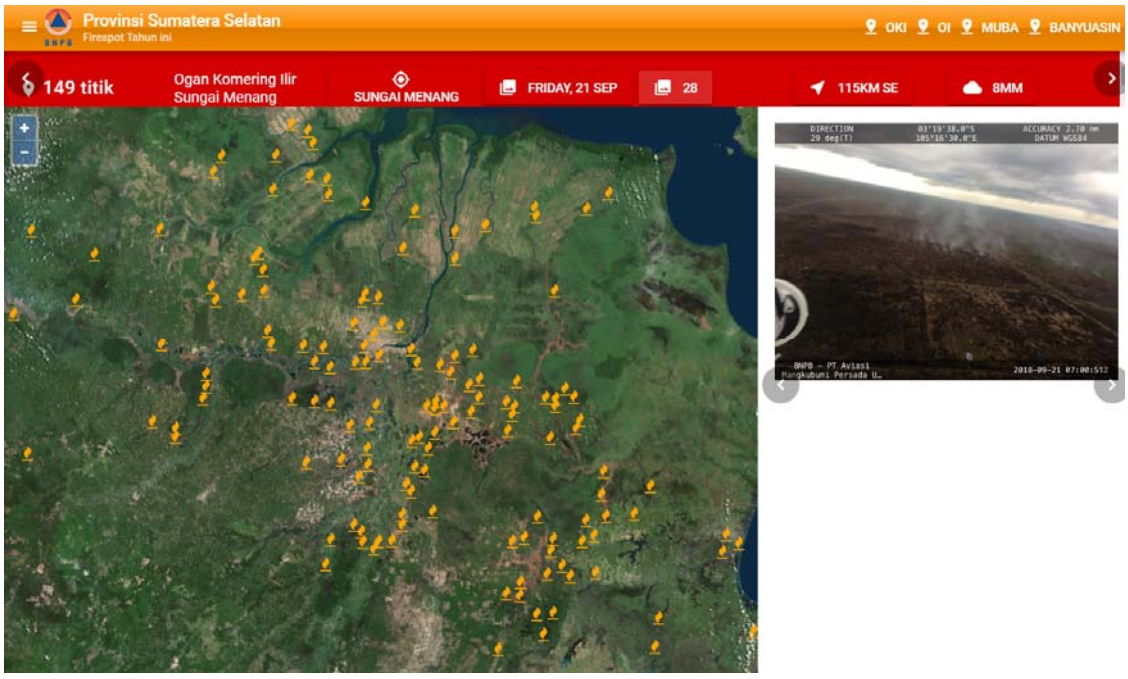
- In September 2015, the Supreme Court ordered Kallista Alam to pay Rp 366 billion fine for illegally burning large swathes of the Tripa forest in Aceh.
- The mining company PT Selat Nasik Indokwarsa was found guilty of environmental damage on Belitung Island, and the company was ordered to pay Rp 31.5 billion in fines

Source: Hans Nicholas Jong, The Jakarta Post
http://www.thejakartapost.com/news/2017/02/09/government-wins-in-forest-fire-case.html

I3.3.4 Combatting with Peatland Fire

(1) Monitoring Fire Using Satellite Images

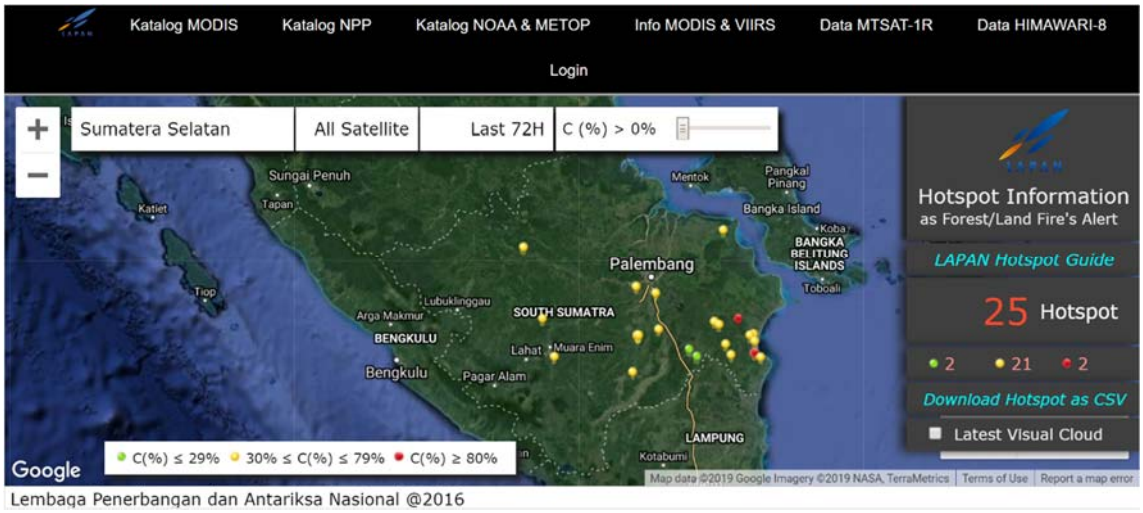
South Sumatra's Disaster Mitigation Agency (BPBD) has developed a decision-making device by using satellite images and onboard images from helicopters (Figure I3.3.4). The BPBD's control room is equipped with screens that show the locations of hot-spots and activities of helicopters. The screen image can also be watched through the internet by the public. It can show statistics of fire the day, the day before, the respective month, and the year. The upper bar shows the nearest fire from the helicopter and the direction and distance, expected precipitation, and movements of all helicopters.



Source: South Sumatra Province

Figure I3.3.4 Decision Making Device of BPBD

Nation-wide hot spots monitor are also on the internet and shown in the control room of the BPBD South Sumatra. Indonesian National Institute of Aeronautics and Space (LAPAN) is providing the live hot-spot information to this system. The home screen is shown in Figure I3.3.5.



Source: Indonesian National Institute of Aeronautics and Space
http://modis-catalog.lapan.go.id/monitoring/

Figure I3.3.5 Nation-Wide Hot-Spots Locator System

(2) Fire-fighting Activities by Helicopters

The Helicopters, dispatched by the National Disaster Mitigation Agency (BNPB), are deployed for fire suppression in South Sumatra Province BPBD. They are stationed at Sri Mulyono Herlambang Air Base in Palembang. They use a water-bombing technique to suppress forest fire. BPBD also deploys patrol helicopters and a weather modification aircraft.

Photo I3.3.1 Water-Bombing

A helicopter of the BNPB is water bombing to put out forest fires.

Source: ANTARA PHOTO/Nova Wahyudi/foc/sh

Supporting Report J

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

The Republic of Indonesia

THE PROJECT
FOR
ASSESSING AND INTEGRATING CLIMATE CHANGE IMPACTS INTO THE WATER RESOURCES MANAGEMENT PLANS FOR BRANTAS AND MUSI RIVER BASINS
(WATER RESOURCES MANAGEMENT PLAN)

FINAL REPORT

Supporting Report J: ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

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PART 1 BRANTAS RIVER BASIN

CHAPTER J1 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN BRANTAS RIVER BASIN

J1.1 List of Dams in RENCANA

RENCANA for Brantas Basin examined 28 dams. Environmental and social conditions for the listed 28 dams were checked.

Table J1.1.1 Environmental and Social Conditions of Dams Listed in RENCANA

No.	Name	Latest Status	Protected Area[1]	Ecosystem	Resettlement	Land use	Downstream Conditions
1. Dam Construction							
1	Genteng I Dam	F/S in 2002	No	According to F/S result, threatened, endangered, vulnerable or protected species (i.e. 16 species of mammal, 1 species of reptile and 5 species of birds) and indigenous fish species were observed in the catchment area of the proposed dam.	According to F/S result, 462 households were classified as directly affected population.	Residential area, paddy field	- Household use (e.g. drinking, cooking, bathing, cloth) - Others (e.g. washing livestock or vehicles)
2	Tugu Dam	Under construction	-	-	-	-	-
3	Beng Dam	F/S in 2003	Production Forest	No information in F/S report	No information in F/S report but large numbers of households in the proposed dam area were found in the satellite image.	Forest, residential area, paddy field	No specific description in F/S report but there were houses at the downstream area.
4	Kedungwarak Dam	F/S in 2005	Production Forest	No information in F/S report	According to F/S report, total 644 households in 2 villages would be affected. According to satellite image, however, houses were not found at the surrounding area.	Forest, residential area	No specific description in F/S report, but paddy field were found in the downstream area according to satellite image.
5	Ketandan Dam[2]	Part of M/P for Brantas River Basin in 1985 F/S in 2005	Production	According to F/S report, the project area was composed of paddy land, upland crop land, housing and home garden land and forest.	According to M/P report, 10 households would be affected.	Forest	Ditto

No.	Name	Latest Status	Protected Area[1]	Ecosystem	Resettlement	Land use	Downstream Conditions
				However, there was no native flora or fauna in the project area.			
6	Semantok Dam	SID in 2013 LARAP in 2015	Production	Since the project area was located in the production forest area, there were annual crops such as teak or bamboo and plantation crops such as coffee, chocolate or coconut, according to F/S report.	156 households (Alt-1)	Forest, residential area	According to F/S report, river water seems to be used for irrigation and household domestic use at the downstream area.
7	Kuncir Dam	F/S in 2008	Production	There was no information on ecosystem in F/S report.	163 households	Forest, residential area	According to satellite image, there were paddy field and the residential area in the downstream area.
8	Babadan Dam	Part of M/P for Brantas River Basin in 1985	No	There was no information on ecosystem in M/P report.	No information. However, houses were found at the surrounding area from satellite image.	Paddy field, residential area	According to satellite image, there were paddy field and the residential area in the downstream area.
9	Lesti III Dam	F/S in 1995	No	There was no information on ecosystem in M/P report.	No information in the report. However, houses were confirmed at the surrounding area from satellite image.	Paddy field, residential area	According to satellite image, there were paddy field and the residential area in the downstream area.
10	Kepanjen Dam	Part of M/P for Brantas River Basin in 1985	No	There was no information on ecosystem in M/P report.	No information in the report. However, houses were confirmed at the surrounding area from satellite image.	Paddy field, residential area	According to satellite image, there were paddy field and the residential area in the downstream area.
11	Lumbang Sari Dam	Part of M/P for Brantas River Basin in 1985	No	There was no information on ecosystem in M/P report.	No information. However, houses were confirmed at the surrounding area from satellite image.	Paddy field, residential area	According to satellite image, there were paddy field and the residential area in the downstream area.
12	Kesamben Dam	Review F/S in 1982	No information of coordinates	-	-	-	-
13	Konto II Dam	Part of M/P for Brantas River Basin in 1985	Production	There was no information on ecosystem in M/P report.	No information in the report. However, houses were confirmed at the surrounding area from satellite image.	Forest, residential area	According to satellite image, there were forest, agriculture land and residential area in the downstream area.
14	Bagong Dam	SID in 2014 LARAP in	Protection	There was no information on	According to LARAP,	Forest, paddy field,	According to LARAP, water

No.	Name	Latest Status	Protected Area[1]	Ecosystem	Resettlement	Land use	Downstream Conditions
		2016		ecosystem in M/P report.	inundation area would be 28.4 ha and 517 households in total would be affected.	residential area	around this area is used for irrigation, bathing, domestic use and fishing.
15	Kampak Dam	F/S in 2016	Production	There was no information on ecosystem in F/S report.	No information in the report. However, houses were confirmed at the surrounding area from satellite image. There is a possibility to cause resettlement.	Forest, residential area	According to satellite image, the downstream area is uses for forest and the residential area.
16	Nglemi Dam	No information	No information	No information	No information	No information	No information
17	Sumber Agung Dam	No information	No information	No information	No information	No information	No information
18	Kembang an	No information	No information	No information	No information	No information	No information
19	Kali Lanang	No information	No information	No information	No information	No information	No information
20	Marmoyo Dam	Briefing material prepared in 2010	Production	No information	Approx. 1.9 ha was regarded as the inundated area.	Paddy field, residential area	No information in the report, but paddy field and residential area are located at the downstream area.
21	Brangkal – Plandaan Dam	No information	No information	No information	No information	No information	No information
22	Kembar Dam Jenesgelar an – Jurangban g	No information	No information	No information	No information	No information	No information
23	Kopen Dam	No information	No information	No information	No information	No information	No information
24	Jarak Dam	No information	No information	No information	No information	No information	No information
25	Gembrong Dam	SID in 2010	No	No information	3.6 ha of reservoir area was planned. Residential areas were existed at the surrounding area.	Vacant	No information in the report, but paddy field and residential area are located at the downstream area.
26	Jatijejer Dam	No information	No information	No information	No information	No information	No information
27	Jinggring Dam	SID in 2016	No	No information	No information. Since the report said that 1.62 ha of reservoir area, there is a possibility of resettlement.	Paddy field, residential area	No information in the report, but paddy field and residential area are located at the downstream area.
28	Sabo Dinoyo Dam	No information	No information	No information	No information	No information	No information
2. Dike Improvement/ Construction							
1	Brantas River	No information	No	No information. However, the planning area is	No information. However, according to the	Paddy field and residential	Paddy field and residential area

No.	Name	Latest Status	Protected Area[1]	Ecosystem	Resettlement	Land use	Downstream Conditions
				the residential and agriculture area. Thus, vulnerable or valuable ecosystem is not considered as located.	satellite image, there were residential areas at the both river sides and the closest distance between the river bank and the residential area might be less than 10 m.	area	
2	Widas River	No information	No	No information. However, the planning area is the residential and agriculture area. Thus, vulnerable or valuable ecosystem is not considered as located.	No information. According to the satellite image, there were residential area at the both river sides. The distance between the river banks and the residential areas were more than 70 m.	Paddy field and residential area	Paddy field and residential area
3	Sadar River	No information	No	No information. However, the planning area is the residential and agriculture area. Thus, vulnerable or valuable ecosystem is not considered as located.	No information. According to the satellite image, there were residential area at the both river sides. The distance between the river banks and the residential areas were more than 20 m.	Paddy field and residential area	Paddy field and residential area
4	Brangkal River	No information	No	No information. However, the planning area is the residential and agriculture area. Thus, vulnerable or valuable ecosystem is not considered as located.	No information. According to the satellite image, the residential areas were located at some points along the river. Distance between the river bank and some of the residential area was narrow.	Paddy field and residential area	Paddy field and residential area
5	Tawing River	No information	No	No information. However, the planning area is the residential and agriculture area. Thus, vulnerable or valuable ecosystem is not considered as located.	No information. According to the satellite image, the residential areas were located at some points along the river. Distance between the river bank and some of the residential area was narrow.	Bush and residential area	Bush, residential area

1: Information of Protected Area is based on the forest map in East Jawa.

2: Study report for Ketandan Dam is in the part of F/S Kedungwarak Dam because Kedungwarak Dam and Ketandan Dam are two dams that connected by connection tunnel

Source: JICA Project Team 2

J1.2 Provisional Scoping

J1.2.1 Provisional Scoping for Construction/ Improvement of Dams

Provisional scoping for construction/ improvement of dams at the pre-construction, construction and operation phases were examined as shown below.

The environmental and social impacts were evaluated as A to D in accordance with the following criteria;

A (+/-): Significant positive/negative impact is expected at this study level.
B (+/-): Positive/negative impact is expected but not significant at this study level.
C: Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: Negligible or no impact is expected at this study level.

Table J1.2.1 Scoping for Construction/Improvement of Dams

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
Pollution	1	Air pollution	B-	D	**Construction phase**： Temporary air pollution by construction equipment and machines is assumed. **Operation phase:** Air pollution due to dam operation is not assumed.
	2	Water pollution	B-	B-	**Construction phase:** Temporary water pollution due to construction works is assumed. **Operation phase:** In case flushing is conducted as the measures for sedimentation, degradation of water quality at the downstream area is assumed.
	3	Waste	B-	B-	**Construction phase:** Soil from construction and waste wood are assumed. **Operation phase:** Sedimentation will be generated in case dredging is conducted.
	4	Soil contamination	C	C	**Construction phase:** Soil contamination due to construction work is not assumed. However, if soil is already contaminated, contaminated soil may be stirred by construction works. **Operation phase:** Any activities to cause soil contamination in dam operation are not assumed. However, if soil flowing into a dam from the upstream area is already contaminated, soil existing in a dam will be affected.
	5	Noise and Vibration	B-	D	**Construction phase:** Noise and vibration from construction works are assumed at some degree. **Operation phase:** Noise and vibration from dam operation is considered as negligible.
	6	Ground subsidence	C	D	**Construction phase:** In case abundant amount of groundwater is used for construction works, a risk of ground subsidence around the construction site will be increased. **Operation phase:** Ground subsidence due to operation of a dam is not expected since a dam will be designed not to cause subsidence by its dead weight.
	7	Offensive odor	D	D	**Construction phase:** Offensive odor related to construction works is not assumed. **Operation phase:** Activities which may cause offensive

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
					odor in dam operation are not expected.
	8	Bottom Sediment	D	B-	**Construction phase:** Bottom sediment related to the construction works is not assumed. **Operation phase:** Sedimentation from the upstream river is assumed at some degree.
Natural environment	9	Protected areas	B-	B-	**Construction phase/Operation phase:** Some of planning sites are located in the production forest.
	10	Ecosystem	C	C	**Construction phase/Operation phase:** Constructing a new dam will need large area of land and will change land use in and around the construction site. Changing land use in the large area is considered to change ecosystem in the area. Need further examination.
	11	Hydrology	C	C	**Construction phase/ Operation phase:** There is a possibility of changing hydrological conditions if a function of water sources or river conditions is changed. Need further examination.
	12	Topography and geology	C	C	**Construction phase/Operation phase:** If the topographical and geological conditions in and around the construction sites are stable, significant impact may not be assumed. Need further examination.
Social environment	13	Land acquisition/Involuntary resettlement	B-	D	**Pre-construction and planning phase:** Land acquisition is assumed, and accordingly, involuntary resettlement is assumed at some areas where residential houses are located. **Operation phase:** Additional land acquisition and involuntary resettlement are not expected after commencement of the operation.
	14	Poverty	C	C	**Construction phase:** If land belonged to the poverty households is acquired or the poverty households are required involuntary resettlement, their livelihood may be affected. On the other hand, construction of new dams may create job opportunities to the surrounding communities including the poverty households at the construction phase. Need further examination. **Operation phase:** There is a possibility that living condition of poverty groups will not be improved after land acquisition or resettlement in case appropriate measurements for livelihood restoration are not applied. Need further examination.
	15	Ethnic minority and indigenous people	C	C	**Construction phase/ Operation phase:** According to *Ensiklopedi Suku Bangasa Di Indonesia* (Department Pendidikan Dan Kebudayaan Ri, 1995), ethnic groups in Jawa East province are Jawa, Madura, Tengger and Osing groups. In addition to these groups, there is a possibility that minority groups live in the planning construction sites. Need further examination.
	16	Local economy (Living and livelihood)	B-	B-	**Pre-Construction phase/ Construction phase/ Operation phase:** There is a possibility that living and livelihood of local communities (surrounding communities) may be affected due to land acquisition by construction of new dams.
	17	Land use and local resources	B-	B-	**Pre-Construction phase/ Construction phase/ Operation phase:** There is a possibility to affect land use and local resources due to land acquisition, especially

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
					acquiring cultivated land and the production forest.
	18	Water usage	B-	B-	**Construction phase:** In case the river water is used in surrounding the project area, the impact of muddy water from construction may affect water use temporarily. **Operation phase:** Water use at the downstream area may be depended on operation of a new dam. In addition, there is a possibility that water amount at the recession area may be affected.
	19	Existing social infrastructure and service	B-/B+	D	**Construction phase:** The traffic jam during the construction works are assumed. In addition, there is a possibility that access to social infrastructure is limited due to construction works. On the other hand, there will be beneficial impact to improve existing road at the surrounding communities in order to improve accessibility of construction vehicles. **Operation phase:** Operation of new dams will not affect existing social infrastructure and service.
	20	Social institutions such as social infrastructure and local decision-making institutions	B-/B+	B+	**Pre-construction phase:** There is a possibility to cause negative impact such as land acquisition or resettlement. Accordingly, impact to social institutions or local decision-making may be assumed if project plan is not properly informed at the proper timing to the local communities. **Construction phase/ Operation phase**: There is a beneficial impact to create job opportunities related to the project and to stable water resource management.
	21	Misdistribution of damage and benefit	B-/B+	B+	**Pre-construction phase:** Same as "Social institutions such as social infrastructure and local decision-making institutions", impact is assumed at some degree. **Construction phase/ Operation phase:** Same as "Social institutions such as social infrastructure and local decision-making institutions", impact is assumed at some degree.
	22	Local conflict of interest	B-/B+	B+	**Construction phase/ Operation phase:** Same as "Social institutions such as social infrastructure and local decision-making institutions", local conflict of interest due to damage and benefit is assumed at some degree.
	23	Cultural heritage	C	C	**Construction phase/ Operation phase:** According to interview to the relevant authority, several culturally important assets are located at upstream, midstream and downstream areas in the Brantas River basin.
	24	Landscape	B-	B-	**Construction phase/ Operation phase:** Land scape will be changed when a new dam is constructed.
	25	Gender	D	D	**Construction phase/ Operation phase:** Special damage or impact to the gender due to construction or operation of a new dam is not assumed.
	26	Children's right	D	D	**Construction phase/ Operation phase:** Special damage or impact for children's right due to construction or operation of a new dam is not assumed.
	27	Infectious disease such as HIV/AIDS	B-	D	**Construction phase:** Expanding of the infectious disease is expected due to influx of construction workers. **Operation phase:** The impact of the infectious diseases is not expected at the operation phase.
	28	Occupational Health	B-	D	**Construction phase/ Operation phase:** Impact on the

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
		and safety			working conditions of the workers is anticipated if construction and maintenance activities are not implemented properly.
Others	29	Accident	B-	B-	**Construction phase/ Operation phase:** The accidents under construction are expected. **Operation phase:** The traffic accidents are expected because of the increase of amount and speed of traffics.
	30	Cross-border impact, climate change	D	D	**Construction phase:** Small scale and temporary generation of greenhouse gases like CO_2 are expected due to construction vehicles and machines. However, impact on transboundary and climate change is negligible. **Operation phase:** The impacts of cross-border and climate change due to operation of a new dam are not expected.

Source: JICA Project Team 2

J1.2.2 Provisional Scoping for Construction/ Improvement of Dikes

Provisional scoping for construction/ improvement of dike at the pre-construction, construction and operation phases were examined as shown below.

The environmental and social impacts were evaluated as A to D in accordance with the following criteria;

A (+/-): Significant positive/negative impact is expected at this study level.

B (+/-): Positive/negative impact is expected but not significant at this study level.

C: Extent of impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: Negligible or no impact is expected at this study level.

Table J1.2.2 Scoping for Construction/Improvement of Dikes

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
Pollution	1	Air pollution	B-	D	**Construction phase：** Temporary air pollution by construction equipment and machines is assumed at some degree. **Operation phase:** Air pollution is not assumed.
	2	Water pollution	B-	D	**Construction phase:** Temporary water degradation from construction works is assumed at some degree. **Operation phase:** Degradation of water quality is not assumed.
	3	Waste	B-	D	**Construction phase:** Soil from construction and waste wood are assumed. **Operation phase:** Generating waste is not assumed.
	4	Soil contamination	C	D	**Construction phase:** Soil contamination due to construction work is not assumed. However, if soil is already contaminated, contaminated soil may be stirred by construction works. **Operation phase:** Any activities to cause soil contamination in dike operation are not assumed.

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
	5	Noise and Vibration	B-	D	**Construction phase:** Noise and vibration from construction works are assumed at some degree. **Operation phase:** Generating noise and vibration is not assumed.
	6	Ground subsidence	C	D	**Construction phase:** In case abundant amount of groundwater is used for construction works, a risk of ground subsidence around the construction site will be increased. Need further examination. **Operation phase:** Ground subsidence due to operation of a dike is not expected since a dike will be designed not to cause subsidence by its dead weight.
	7	Offensive odor	D	D	**Construction phase:** Offensive odor related to construction works is not assumed. **Operation phase:** Activities which may cause offensive odor in Dike operation are not expected.
	8	Bottom Sediment	D	D	**Construction phase/ Operation phase:** Bottom sediment related to the construction or operation works is not assumed.
Natural environment	9	Protected areas	D	D	**Construction phase/Operation phase:** Planning sites are assumed as not located in the protected areas.
	10	Ecosystem	D	D	**Construction phase/Operation phase:** The planning sites to construct new dikes are already developed. Therefore, it is assumed that construction of new dikes does not to cause impact to ecosystem in the area.
	11	Hydrology	D	D	**Construction phase/ Operation phase:** New dikes will be constructed along the river (not inside the river). In addition, construction of new dikes will not change water resources in the area. Thus, it is assumed that hydrological conditions will not be changed due to construction of new dikes.
	12	Topography and geology	C	C	**Construction phase/Operation phase:** If the topographical and geological conditions in and around the construction sites are stable, significant impact may not be assumed. Need further examination.
Social environment	13	Land acquisition/Involuntary resettlement	B-	D	**Pre-construction and planning phase:** Land acquisition are assumed though it may not be a large area. Involuntary resettlement is also assumed at some areas where residential houses are located very close to the rivers. **Operation phase:** Additional land acquisition and involuntary resettlement are not expected after the commencement of the operation.
	14	Poverty	B-/B+	B+	**Pre-construction and Construction phase:** If land belonged to the poverty households is acquired or the poverty households are required involuntary resettlement, their livelihood will be affected. However, since large area may not be required for construction of new dikes, land-based impact to poverty is considered as small. Construction of a new dike may provide job opportunities to the surrounding communities including the poverty households at the construction phase. **Operation phase:** Operation of dikes will not affect poverty. After dikes are constructed or existing dikes are upgraded, impact to the poverty groups due to flood is

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
					considered as minimized.
	15	Ethnic minority and indigenous people	C	C	**Construction phase/ Operation phase:** According to *Ensiklopedi Suku Bangasa Di Indonesia* (Department Pendidikan Dan Kebudayaan Ri, 1995), ethnic groups in Jawa East province are Jawa, Madura, Tengger and Osing groups. In addition to these groups, there is a possibility that minority groups live in the planning construction sites. Need further examination.
	16	Local economy (Living and livelihood)	B-	B+	**Pre-Construction and Construction Phase:** Some of areas along the rivers are used as cultivated land. Thus, there is a possibility that living and livelihood of local communities (surrounding communities) may be affected if such land is acquired though acquired area is assumed as small. **Operation phase:** After construction of dike, living and livelihood of local people along the rivers may be improved since frequency or level of flood may be minimized compared with the current conditions.
	17	Land use and local resources	B-	D	**Pre-Construction and Construction Phase:** Some of areas along the rivers are used as cultivated land. Thus, there is a possibility that living and livelihood of local communities (surrounding communities) may be affected if such land is acquired though acquired area is considered as small. **Operation phase:** Impact to land use and local resources are not assumed after operation of dikes.
	18	Water usage	D	D	**Construction phase/ Operation phase:** Water use is not assumed to be affected.
	19	Existing social infrastructure and service	B-/B+	D	**Construction phase:** The traffic jam during the construction works are assumed. In addition, there is a possibility that access to social infrastructure is limited due to construction works. On the other hand, there will be beneficial impact to improve existing road at the surrounding communities in order to improve accessibility of construction vehicles. **Operation phase:** Any activities to cause impact to existing social infrastructure and service are not assumed.
	20	Social institutions such as social infrastructure and local decision-making institutions	B-	B+	**Pre-construction phase:** There is a possibility to cause negative impact such as land acquisition or resettlement. Accordingly, impact to social institutions or local decision-making may be assumed if project plan is not properly informed at the proper timing to the local communities. **Construction phase/ Operation phase**: There is a beneficial impact to create job opportunities related to the project and to reduce a risk of flood.
	21	Misdistribution of damage and benefit	B-/B+	B+	**Pre-construction phase:** Same as “Social institutions such as social infrastructure and local decision-making institutions”, impact is assumed at some degree. **Construction phase/ Operation phase:** Same as “Social institutions such as social infrastructure and local decision-making institutions”, impact is assumed at some degree.
	22	Local conflict of	B-/B+	B+	**Pre-construction phase:** Same as “Social institutions

Category		Item	Evaluation		Reason for evaluation
			PC/CP	OP	
		interest			such as social infrastructure and local decision-making institutions", impact is assumed at some degree. **Construction phase/ Operation phase:** Same as "Social institutions such as social infrastructure and local decision-making institutions", impact is assumed at some degree.
	23	Cultural heritage	D	D	**Construction phase/ Operation phase:** According to interview to the relevant authority, several culturally important assets are located at upstream, midstream and downstream areas in the Brantas River basin. However, it is assumed that cultural heritage is not located at the river bank areas.
	24	Landscape	B-	B-	**Construction phase/ Operation phase:** Land scape will be changed in case dikes are newly constructed or existing dikes are upgraded.
	25	Gender	D	D	**Construction phase/ Operation phase:** Special damage or impact to the gender due to construction or operation of a new dam is not assumed.
	26	Children's right	D	D	**Construction phase/ Operation phase:** Special damage or impact for children's right due to construction or operation of a new dam is not assumed.
	27	Infectious disease such as HIV/AIDS	B-	D	**Construction phase:** Expanding of the infectious disease is expected due to influx of construction workers. **Operation phase:** The impact of the infectious diseases is not expected at the operation phase.
	28	Occupational Health and safety	B-	D	**Construction phase/ Operation phase:** Impact on the working conditions of the workers is assumed if construction and maintenance activities are not implemented properly.
Others	29	Accident	B-	D	**Construction phase/ Operation phase:** The accidents under construction are assumed. **Operation phase:** The accidents due to related to dikes are not assumed.
	30	Cross-border impact, climate change	D	D	**Construction phase:** Small scale and temporary generation of greenhouse gases like CO_2 are expected due to construction vehicles and machines. However, impact on transboundary and climate change is negligible. **Operation phase:** The impacts of cross-border and climate change due to operation of new dikes is not assumed.

Source: JICA Project Team 2

J1.3 Stakeholder Meetings

Total 3 times of Stakeholder Meetings (SHM) were held to explain the project outline and examination results as well as having opinion exchange. Summary of each stakeholder meeting is shown below.

Table J1.3.1 Summary of Stakeholder Meetings (Brantas River Basin)

	Date and Venue	No. of Participants	Major Discussion Points
1st SHM	5 Feb. 2016 10:00 – 11:30 Hall BBWS Brantas, Surabaya	32 persons	➢ There was a question whether the project dealt with the climate change only or not. It was answered from the JICA Project Team 2 that other factors would consider separately. ➢ There was a suggestion to make a guideline of proper water management to improve the current problematic conditions of water use. ➢ There was a question of difference between SEA and EIA. It was answered from the JICA Project Team 2 that SEA evaluates broader issues at more comprehensive level through obtaining feedback from key stakeholders.
2nd SHM	15 Sep. 2016 15:00 – 16:30 Swiss Belinn Tunjungan, Surabaya	33 persons	➢ There was a request to explain the calculation method of maximum flood discharge in 2050. It was answered from the JICA Project Team 2 that 2 approaches (i.e. i) calculation for the large catchment area, and ii) calculation for tributaries as small catchment area). ➢ There was a comment of importance on people's education since types of problem may be differed at upper, middle and downstream. It was answered from the JICA Project Team 2 that continuous education by NGO is important. ➢ There was a comment of weakness on law enforcement to implement regulations though there were many regulations. It was suggested from the JICA Project Team 2 to mention law enforcement when POLA is revised.
3rd SHM	29 Nov. 2017 9:00 – 11:30 Regent's Park Hotel, Malang	60 persons	➢ There was a comment to examine water quality in SEA since water quality in Brantas River Basin was serious. It was answered from the JICA Project Team 2 that water quality was examined in this project and the examination result would be included in the final report. ➢ There was a comment to examine more rational adaptation measures and to possibility to heighten Sutami Dam. It was answered from the JICA Project Team 2 that more rational adaptation measures were examined. As for Sutami Dam, behind the existing Sutami Dam (not heightening Sutami Dam itself) would be heightened.

Source: JICA Project Team 2

J1.3.1 The First Stakeholder Meeting

The details of the meeting are described below.

Date: 5 Feb. 2016 (Fri.) 10:00 - 11:30

Place: Hall BBWS Brantas

Documents distributed:

(1) Strategic Environmental Assessment (SEA) in the Project

(2) General Outline of the Project

Proceedings

(1) JICA Project Team 2 explained the project outline below.

- This is the project to assess impact of climate change at the Brantas river basin and the Musi river basin respectively.
- As for the Bratas river basin, following items would be conducted:
  - Evaluate vulnerability and resilience of water resources management by climate change,
  - Propose how to include climate change into POLA and RENCANA, and
  - Prepare the guideline for applying POLA and RENCANA to other river basin
- The project has been suspended for more than 1 year becaise obtaining rainfall data from BMKG took time.

There were comments and questions to the project outline.

Comment. 1: PU is working on climate change assessment (started the study in 2007, proposed project budget in 2011). I would like to know the current result since we have started discussion on this project since 3 years. (Chairman, Head of Administration Division BBWS-Brantas)

Question. 1 (Qs.1): What is the reason of delaying the project? (BMKG Staff)

Answer 1 (As.1): BMKG headquarters did not approve furnishing daily rainfall data in the Musi river basin. It took a long time to solve this issue. (JICA Project Team 2)

Qs. 2: There are some problems on future conditions, for example, changing land use, etc. Does this project examine only climate chage? (Staff from Institut Teknologi Sepuluh: ITS)

As. 2: Influence of changing of land use in 2050 was already recognized. If possible, we would like to consider impact on climage change and other issues separetely. (JICA project Team 2)

Qs. 3: I could understand the project outline. Could you show the POLA and RENCANA in consideration of climate change ? (University Brawijaya)

As. 3: This project is aimed to study for POLA and RENCANA. We will examine impact of climage change from now on. It is possible to explain the Draft Final Report (JICA Project Team 2)

(2) JICA Project Team 2 explained climate change below.

- Flood discharge is larger, and lower discharge is smaller than the present conditions as the flow duration curve from the climate change analysis using GCM shows.
- There are 3 furture senarios for the presenti situation. We will carry out the water balance analysis for each senario.
- The project has been suspended for more than 1 year becaise obtaining rainfall data from BMKG took time.

There were comments and suggestions to climate change.

Suggestion. 1: Since Brantas river was developed, I think climate change impact is already considered for planning. In this presentation, I could not understand details of climate change impact. I would like to know more information. If you may need manpower, university could cooperate for this project (University Brawijaya)

Suggestion. 2: Regarding climate change impact, experts already aware of this issue though general public did not aware it. General public only feel that floods are occurred in the rainy season and droughts are occurred in the dry season. There is a need to create rules for water use of the residents. (Participant)

Suggestion. 3: Previously, the delta area of Surabaya river and Porong river was a place without any problems for water use. The delta area has become the industrial area, then, there are problems on the river water level and underground water. For this reason, a guideline on proper water intake amount at domestic water and industrial water is necessary to be prepared by the government. (Staff from ITS)

Qs. 4: Why the study only in Sutami and Lengkon I think that JICA already knows many domes in addition to Sutami and Lengkon. (JASA TIRTA Staff)

As. 4: We showed flow duration curves at these dams as an example. In future climate conditions, water storage capacity of dams might be decreased. It is common for all dams. (JICA project Team 2)

(3) JICA Project Team 2 explained Strategic Environmental Assessment (SEA) below.

- SEA is a method for integration of environmental and social considerations into policies, plans and programs. This is systematic, comprehensive and participatory approach.
- The key issues related the Brantas river basin are mainly following 3 points:
- How does climate change affect environmental baseline and objectives of POLA/RENCANA?
  - How will climate change be adapted to water resources management?
  - How will planning process be improved in the context of climate change?

There were comments and suggestions to climate change.

Suggestion. 4: In the presentation of JICA Project Team 2, SEA is said to be a new approach in Indonesia. However, there was a precedent project in Indonesia. In 2009, we used this method in the project near river in order to obtain agreement of the stakeholders and local residents. (Staff from ITS)

Suggestion. 5: There is a need to consider not only surface water but also underground water. (Staff from BBWS Brantas)

Comment: There may be indirect impact on ground water. For example, reduction in available surface water due to climate change may accelerate extraction of groundwater. The issue of groundwater will be looked at during SEA though I cannot detailed answer the depth/level of analysis at this point. (JICA Project Team 2)

Suggestion. 6: There was a case where a factory in the vicinity of Surabaya river tried to take underground water for industrial use and caused reduction in the river water level. (Staff from ITS)

Qs. 5: It looks that SEA is compulsory in the project. However, I do not know the SEA. What is the difference between SEA and EIA (AMDAL)? (Staff from PJT-1)

As. 5: SEA evaluated broader issues at a more comprehensive level, and therefore, obtaining feedback from the key stakeholders is important in SEA. (JICA Project Team 2)

Suggestion. 7: We prepared POLA for Brantas river basin in 2010. However, due to environmental change, we have to review it every 5 years. It is important to attend the review and opinion of key stakeholders in the process. (Staff from BBWS Brantas)

J1.3.2 Second Stakeholder Meeting

The details of the meeting are described below.

Date: 15 Sep. 2016 (Thu.) 15:00 - 16:30

Place: Swiss Belinn Tunjungan, Surabaya

Documents distributed:

Strategic Environmental Assessment for Improving Water Resources Governance and Decision Making in the Context of Climate Change [2nd Stakeholder Meeting for Brantas River Basin]

1. Proceedings

(1) Introduction by the Moderator (Moderator: Officer from BBWS Brantas)

The following explanation was done by the moderator.

At the moment JICA Project Team 2 is conducting 2 studies in Brantas River Basin and Musi River Basin. This activity is a model case to be implemented to another river basin in Indonesia. This is the large-scale study. Accordingly, participants especially TKPSDA members are requested to provide any inputs, suggestion, etc. The presentation includes general information about prediction regarding water demand in the current and future conditions and information about relationship between changes of land use and water quality condition.

Studies related to BBWS is usually included in the TKPSDA meeting one of discussion topics in order to provide any comments or confirmation from TKPSDA members to polish such studies.

(2) Presentation was done by JICA Project Team 2

- Project background (i.e. the condition of climate change in Indonesia especially in Java, greenhouse gas emission in 2020 and POLA and RENCANA at each river basin), outline, and the current and future condition in Brantas River Basin
- Provisional countermeasures/alternatives examinations under the future condition in 2050.
- Overall explanation about SEA that included the definition of SEA, the flow of SEA, and the status of SEA in Indonesia.
- SEA approach applied for this project.
- Example of parameters for selecting optimum countermeasures.

There were comments and questions as follows.

Qs.1: Please give me the quick explanation in calculating the maximum flood discharge especially in the downstream of New Lengkong and Widas River basin in 2050. Have you considered including the measure that have been done now, for example "flood forecast and early warning system", and what is the benefit of the system and what can be maximized from current system? Do we need to install a new system?

And regarding the SEA, I think we have different type of study in Indonesia. The environmental study in Brantas River Basin was done by the environmental service agency though the study focused on water quality, ecosystem and social economy of the people. I suggest you to read the SEA report that can be obtained at environmental agencies in Surabaya (Staff from PJT-1).

As.1: We applied two kinds of approaches. One is for the mainstream at Brantas River Basin as a huge catchment area. In this case, we applied the difference between current and future rainfall. For tributaries as small catchment area, calculation of runoff analysis conducted by Tokyo University was used. Regarding the FFEW System, it was suggested to use the accurate FFEW System. (JICA Project Team 2)

Qs.2: The problem of river in Brantas can be divided to three areas; upstream, middle area and downstream. The problem in the upstream area is decreasing about 50% of the water source. In addition, the high degree of surface runoff causes drought in the dry season and flood in the rainy season. In the middle and downstream area, the problem is low water quality due to pollution from garbage thrown into a river and from domestic and industrial wastewater. This problem will be continuously happened. The problem related to the river will be increased according to population growth. There are some suggestions regarding 5 pillars of criteria. Although we already know that global warming and water crisis is crucial problem in the world, we would like to add that moral crisis is also a problem. To overcome moral crisis in the context of river, we built "River School" that is located in Jombang, East Java. There are still many people who don't aware the impact of throwing garbage to the river and taking water from the river. Education is important but not everybody can afford that. So, as an NGO, we try to overcome that problem by building the River School. (Leader of Brantas River Safeguards Society Group, Local NGO)

As.2: Education to people is important, and I will continuously count on NGO lecture by building river school. (JICA Project Team 2)

Qs.3: There are two things that need to be added to the parameter; institution and institutional regulation. There are three factors to be considered for smooth operation of every action:

- Legal aspect → establishing and strengthening the law, regulations, etc.
- Structural aspect → institutional strengthening
- Cultural aspect

(prefer to add more detail explanation, difficult to understand)

I got impression that all five indicators are cultural issues. (National Commission on Environmental in Malang)

As.3: Thank you for your comment. We will study based on your comment regarding those 3 indicators. But, frankly speaking, for the indicator no 5, it is difficult to determine the target. If you have, please give us your idea on the target community or target business role regarding to the water resources management. (JICA Project Team 2)

Qs.4: The plan of this project is very good and inputs from everybody is also good. One thing to be stressed is five indicators. For example, System of Rice Intensification (SRI). I have been working on SRI for about nine years, and we started to get a result from the fifth year because only small number of farmers used the organic fertilizer.

Another problem is social issues. General problem of a river is social problem, especially agricultural system in an area along a river. Farmers tend to use highly concentrated pesticide for their farm, and people living along a river likely to throw their garbage into the river. As for the five indicators, I think it is too wide and needs to be focused. It is suggested to specify parameter for this study. (TKPSDA Bali)

As.4: In the second stakeholder meeting, we try to get comment or idea about general issues. Based on comments or idea, we study in detail.

There is an SRI expert in our company as well. In our proposal for 2050, I also consider including SRI to be applied for the Brantas River Basin. However, there is topographical problem to applying for SRI though some of areas can be applied for SRI. So, for applying SRI, we will do based on topographical condition. (JICA Project Team 2)

Qs.5: We are interested in SEA. We understand that the condition of the Brantas River Basin is already bad. We have to secure the area for the agricultural purpose. However, in the contrary, land in the Brantas River Basin is covered with concrete. About 5-10 years later, there will not be any land to be used as the agricultural area.

The condition in the middle of Brantas is also bad. In Indonesia, there are many regulations, but there is no law enforcement to implement regulations. It is suggested to include law enforcement as one countermeasure. If there is law enforcement, the condition of the river basin will be better. (Secretariat of TKPSDA)

As.5: Law enforcement can be done even if the climate change is not occurred. It is better to mention law enforcement when POLA is revised. Our project target is in 2050, but current POLA is valid until 2030. We will consider putting the law enforcement in our

report, but it will be better if BBWS also mention about law enforcement in the revised POLA or to change the regulation. (JICA Project Team 2)

Chairperson of TKPSDA Brantas introducing JICA Project Team 2	Participants of the TKPSDA Brantas meeting
Presentations about the ptoject outline by JICA Project Team 2	Presentations about the cuurent and future condition in the target area by JICA Project Team 2
Sharing the informations by a participant (NGO Brantas River Safeguards Society Group) in the discussing session	Asking the questions by a participant (PJT1) in the discussion session

Source: JICA Project Team 2

Photo J1.3.1 Photos of 2nd Stakeholders Meeting

J1.3.3 Third Stakeholder Meeting

The details of the meeting are described below.

Date: 29 Nov. 2017 (Thu.) 9:30 - 11:30

Place: Regent's Park Hotel, Malang

Documents distributed:

Strategic Environmental Assessment for Improving Water Resources Governance and Decision Making in the Context of Climate Change [3rd Stakeholder Meeting for Brantas River Basin]

The meeting of TKPSDA was started at around 8:30 a.m. chaired by the Head of OP Implementation Section.

Following presentation on the project outline and SEA was done by JICA Project Team 2.

1. Water Utilization under Future (2050) Conditions in Brantas River Basin
2. Adaptation Measure to Climate Change Impact for Water Utilization
3. Flood under 2050 in Brantas River Basin
4. Adaptation Measure to Climate Change Impact for Flood Management
5. Strategic Environmental Assessment (SEA) conducted in the project

After the presentation, there was a discussion session and during the session, there were questions, opinions, etc. from the participants. The questions and opinions are as follows:

1. Comments and Queries from Secretariat TKPSDA & Answers from JICA Project Team 2

- **Comment 1 (C1):** The condition of water conservation in Indonesia is very severe. However, to build new infrastructure to control the flood will need cost. And to make new canals, we need to build closed canal which is very pricey.

  The study regarding SEA is needed by TKPSDA because it related with POLA. So, if this study target is 2050 and our POLA is until 2030, it will be needed to create new POLA and some review POLAs. If the result of this study can be accepted by all parties and Balai, we hope that it will have strong relation with POLA and Review POLA. The next Review POLA will be in 2020 and 2025, and in 2030 there will be a draft of new POLA. How to connect this study with POLA and Review POLA so that TKPSDA can still follow this study and apply it into POLA for water resource management in Brantas River Basin?

As.1: How to connect this study with POLA and Review POLA because this study target is 2050 and current POLA is until 2030? At the beginning when we calculate future situation, we also considered 2030 as the target of this study, but JICA Project Team 1 mentioned that 2030 is too short to get significant data on impact of climate change, so then we set the target of this study is 2050.

Then, to connect this study with POLA and Review POLA, Balai need to use the same approach with the approach used until now. For example, in using the rainfall data. After that, adding the data from our side regarding the assumption on climate change in the future.

For other basins, we will prepare the guideline about how to apply climate change impact into POLA.

C2: If possible, please provide the report of this study not only in English but also in Bahasa Indonesia.

A2: it is already proposed (but not determined yet) to provide the Bahasa Indonesia for the summary of the report.

2. Comments and Queries from Environmental Department & Answers from JICA Project Team 2

- **C1:** We're welcoming this SEA related study because this is good this study can be used as a media on planning, evaluating and monitoring for institutions related with river basin. To my perception, regarding to climate change, in this study only focusing on controlling flood. We hope that in this study also concerning about the water quality, because at the moment, water quality is serious problem in Brantas river basin which become the source for drinking water in East Java Province.

  SEA is study on environment, so we hope that environmental matrix could be more detail, especially regarding the impact to the environment. It is also needed to know the initial condition of Brantas river basin.

- **As.1:** At the moment, we are doing study on water quality but since the study is not completed yet, we cannot include it in this presentation, but will include it into final report

  Regarding the matrix, we could make more detail matrix based on the information we get today.

3. Comments and Queries from Yayasan Formula Lingkungan and Answer from JICA Project Team 2

- **C1:** 1. In the presentation, we didn't see the indicator or parameter in predicting the water availability and water needs until 2050.

2. Better to give more rational adaptation major, instead of only discourse.

For example, the construction of desalination plant. If the desalination process is done in the factory, the water will have economic value and it will increase its price.

For interconnecting between river basins, is it possible to realize it until 2050?

Is it possible to heighten Sutami Dam?

What we have done to control flood are making the retarding basin and bio pore. It already successful and it will be good if this is also included into this report.

In the future, will all regulations need to do SEA, because at the moment, there are many regulations that didn't conduct SEA.

- **As.1:** In this presentation, we didn't mention the technical matter, we will explain that in another occasion in Balai. Regarding the parameter, we got the data from JICA Project Team 1, and some of the data we don't know the parameter(s). For sharing surplus water, we don't use interconnection between river basins, but using the water tank truck. So, what needs to be done is establish the system between local government without constructing infrastructure. This is the last alternative to overcome insufficiency of drinking water when groundwater is not possible to be explored anymore

  Regarding the heightening of Sutami Dam, it is not on the dam itself, but behind the existing dam. This will not damage the dam's core because there are some study cases in Japan that already succeed.

- **As.1-2:** In guideline of SEA, it is determined what kind of activities will need SEA. If such activities didn't include there, so it means, SEA for that activities no need to be conducted. The parties who conduct the activities should find out about that.

Chairperson of TKPSDA Brantas introducing JICA Project Team 2	Participants of the TKPSDA Brantas meeting
Presentations about the Strategic Environmental Assessment (KLHS) by JICA Project Team 2	Asking the questions by a particioant in the discussing session
Answering the questions by JICA Project Team 2	

Source: JICA Project Team 2

Photo J1.3.2 Photos of 3rd Stakeholders Meeting

PART 2 MUSI RIVER BASIN

CHAPTER J2 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN MUSI RIVER BASIN

J2.1 Record of Stakeholders Meetings

A total of three times of stakeholder meetings (SHM) were held to explain the project outline and examination results followed by discussions. The summary of each stakeholder meeting is shown in Table J2.1.1.

Table J2.1.1 Summary of Stakeholder Meetings (Musi River Basin)

	Date and Venue	No. of Participants	Agenda
1st SHM	1 Nov. 2018 10:20 – 11:20 Conference Hall of 101 Rajawali Palembang Hotel, Palembang	82 persons	➢ Application of Strategic Environmental Assessment (SEA) in the Project as a demonstration ➢ The general outline of the Project
2nd SHM	19 Feb. 2019 13:00 – 17:00 The Conference Hall of BBWS-S.VIII, Palembang	12 persons	➢ Assessment of climate change Impacts in the Musi River basin ➢ Conceivable Adaptation Measures ➢ Impact assessment for the adaptation measures
3rd SHM	25 Apr. 2019 19:20 – 20:40 The Conference Hall of Horison Ultima Hotel, Palembang	60 persons	➢ Assessment of climate change impacts in the Musi River basin ➢ Conceivable adaptation measures ➢ Impact assessment for the adaptation measures ➢ Environmental and social impacts of selected structural measures

Source: JICA Project Team 2

J2.1.1 The First Stakeholder Meeting

The details of the meeting are described below.

Date: 1st Nov. 2018 (Thr.) 10:20 - 11:20

Place: Conference Hall of 101 Rajawali Palembang Hotel, Palembang

Attendance: Refer to Table J2.1.2

Documents distributed:

(1) Strategic Environmental Assessment (SEA) in the Project

(2) General Outline of the Project

Proceedings

JICA Project Team 2, Mr. Yamazaki, explained the followings.

[SEA]

- SEA is a mandatory procedure due to an agreement between DGWR and JICA
- Importance of SEA and differences from AMDAL
- Implementation schedule of SEA Meetings

[Project Outline]

- Some parts of Provinces such as Jambi, Bengkulu, and Lampung Provinces are included in this Project besides South Sumatera Province and excludes Sembilang National Park area and the Eastern side of Sugihan River Basin
- The necessity of this project with its background, such as climate change and the international pledge on CO2 emission reduction
- The goals of this project, such as reflections on climate change measures to Musi River basin management; making draft guidelines; and capacity development
- The end of the project period, set as January 2020
- The two project components: climate change impact assessment (Component-1) and formulation of countermeasures for POLA/RENCANA, draft guidelines (Component-2), and capacity development (Component-1 and 2).
- Progress Report 4 will be presented in this month (November) as stipulated in the reporting schedule
- Capacity development activities such as the installation of water level gauges and making cross-section of the Musi River and its tributaries during the information gathering

There were comments and questions as follows.

Qs. 1: Regarding climate change, we are not only considering the amount of rainfall but also the intensity, where the duration of the rainy season in South Sumatra seems to be decreased from 6 months to 4 months. On the other hand, the dry season became longer, from 6 months into 8 months. What are your recommendations? (Dr. Ir. Slamet Budi Yuwono, MS/Watershed Forum of Lampung Province)

As. 1: I agree with your statements. The trend of rainfall in South Sumatera may be decreasing and the extreme condition seems to be apparent. Detail explanation of climate change will be presented in the 2nd stakeholder meeting. (Yamazaki)

Qs. 2: What are the mitigation and adaptation measures that we can do to face climate change? And what are your main suggestions to reduce climate change impact? (Ir. Erna Yuliwati, Ph.D./ Foundation of Innovation Development Organization of the Prosperous and Independent Society)

As. 2: There are some structure countermeasures that we can do. For example,

- dike construction to prevent flooding,
- construction of reservoirs to store rainwater in the upstream area and secure flood storage capacity, and
- construction of estuary barriers to prevent seawater intrusion regarding sea level rise.

  However, these measures must consider social and environmental impacts as well as economic and financial validities. There is no clear-cut answer for the mitigation measure at this point. (Yamazaki)

Qs. 3: Peatland degradation is apparent in some areas in South Sumatera, they are caused by private companies, who received the concession of forest use in the peatland area, and converting peatland to plantation land. The companies make canals to drain groundwater to dry the wet peatland and set fire. Does this project consider these things or not? You may contact Watershed Forum of South Sumatera in order to get more information regarding peatland. (Ir. Muhammad Yamin, MM./ Maritime and Fisheries Community Care NGO for South Sumatra Province)

As. 3: This project is for sure paying attention to this issue. Yet, this is the responsibility of TRGD. BBWS S-VIII shall cooperate with TRGD and also figure out what BBWS, as a water resourced management body, can do to the peatland area. If anyone has suggestions or questions, please contact our secretary/interpreter. We are open to all suggestions. (Yamazaki)

Qs. 4: Why this project only includes three river basin? (Puspita/WALHI (NGO) South Sumatera)

As. 4: We do not have a clear answer to your question. It is agreed between DGWR and JICA in 2013.

Moderator: I want to add two facts to the questions. At that time in 2013, there was no POLA and RENCANA for Musi River basin, and BBWS S-VIII was responsible only for the three river basins: Musi, Banyuasin, and Sugihan. (Mr. Mawardi/BBWSS VIII)

Photo J2.1.1 Presenters in the stakeholders meeting

Source: JICA Project Team 2

Photo J2.1.2 Participants in the stakeholders meeting

Table J2.1.2 Participants list of #1 SHM

No.	NAME/WORK UNIT/POSITION/ASSOCIATION	Job Title	Jurisdiction/ Place of Interest	Status in TKPSDA	Type of Organization	Attended on Nov. 1, 2018
1.	Regional Development Planning Agency	Head	South Sumatra Prov.	Member (Chair)	Gov't	✔
2.	Water Resources Management Office	Head	South Sumatra Prov.	Member (Daily Chair)	Gov't	✔
3.	Balai Besar Wilayah Sungai Sumatera VIII	Head	River Region VIII	Member	Gov't	✔
4.	Food Crop and Horticulture Office	Head	South Sumatra Prov.	Member	Gov't	✔
5.	Forestry Office	Head	South Sumatra Prov.	Member	Gov't	✔
6.	Environmental and Land Office	Head	South Sumatra Prov.	Member	Gov't	-
7.	Regional Planning, Research, and Development Agency	Head	Bengkulu Prov.	Member	Gov't	✔
8.	Public Works and Spatial Plan	Head	Bengkulu Prov.	Member	Gov't	✔
9.	Food Crop, Horticulture, and Plantation Office	Head	Bengkulu Prov.	Member	Gov't	✔
10.	Bureau of Administration of Economic Affairs and Natural Resources	Head	Bengkulu Prov.	Member	Gov't	✔
11.	Environmental and Forestry Office	Head	Bengkulu Prov.	Member	Gov't	-
12.	Regional Development Planning Agency	Head	Jambi Prov.	Member	Gov't	-
13.	Public Works and Housing Office	Head	Jambi Prov.	Member	Gov't	✔
14.	Environmental Office	Head	Jambi Prov.	Member	Gov't	✔
15.	Forestry Office	Head	Jambi Prov.	Member	Gov't	✔
16.	Bureau of the Development and Cooperation of Regional Secretariat	Head	Jambi Prov.	Member	Gov't	✔
17.	Regional Development Planning Agency	Head	Lampung Prov.	Member	Gov't	✔
18.	Human Settlements and Water Resources Management Office	Head	Lampung Prov.	Member	Gov't	-
19.	Environmental Office of	Head	Lampung Prov.	Member	Gov't	✔
20.	Forestry Office	Head	Lampung Prov.	Member	Gov't	-
21.	Regional Development Planning Agency	Head	West Lampung Regency	Member	Gov't	✔
22.	Public Works and Spatial Plan Office	Head	Palembang City	Member	Gov't	✔
23.	Public Works and Spatial Plan Office	Head	Banyuasin Regency	Member	Gov't	-
24.	Environmental Office	Head	Musi Banyuasin Regency	Member	Gov't	-
25.	Public Works and Spatial Plan Office	Head	Ogan Ilir Regency	Member	Gov't	-
26.	Public Works and Spatial Plan Office	Head	Ogan Komering Ilir Regency	Member	Gov't	✔
27.	Public Works and Spatial Plan Office	Head	Prabumulih City	Member	Gov't	✔
28.	Public Works and Spatial Plan Office	Head	Muara Enim Regency	Member	Gov't	✔
29.	Public Works and Spatial Plan Office	Head	Lahat Regency	Member	Gov't	✔
30.	Public Works and Spatial Plan Office	Head	East OKU Regency	Member	Gov't	✔
31.	Public Works and Housing Office	Head	Ogan Komering Ulu Regency	Member	Gov't	-
32.	Public Works and Spatial Plan Office	Head	South OKU Regency	Member	Gov't	✔
33.	Public Works and Spatial Plan Office	Head	Empat Lawang Regency	Member	Gov't	-
34.	Public Works Office of Human Settelement, Spatial Plan and Irrigation	Head	Musi Rawas Regency	Member	Gov't	✔
35.	Public Works and Spatial Plan Office	Head	Lubuklinggau City	Member	Gov't	✔
36.	Public Works and Spatial Plan, Housing and Settlement Area Office	Head	Rejang Lebong Regency	Member	Gov't	✔

No.	NAME/WORK UNIT/POSITION/ASSOCIATION	Job Title	Jurisdiction/ Place of Interest	Status in TKPSDA	Type of Organization	Attended on Nov. 1, 2018
37.	Public Works Office	Head	Kepahiang Regency	Member	Gov't	✔
38.	Public Works and Spatial Plan Office	Head	Central Bengkulu Regency	Member	Gov't	-
39.	Public Works and Housing Office	Head	West Lampung Regency	Member	Gov't	✔
40.	Public Works and Spatial Plan Office	Head	Pagaralam City	Member	Gov't	✔
41.	Public Works and Spatial Plan Office	Head	Sarolangun Regency	Member	Gov't	✔
42.	Public Works and Spatial Plan Office	Head	Muaro Jambi Regency	Member	Gov't	✔
43.	Public Works and Spatial Plan Office	Head	Batang Hari Regency	Member	Gov't	-
44.	Public Works and Spatial Plan Office	Head	East Tanjung Jabung Regency	Member	Gov't	✔
45.	Regional Agency for Disaster Management	Head	North Musi Rawas Regency	Member	Gov't	✔
46.	Public Works Office	Head	Penukal Abab Lematang Ilir (PALI) Regency	Member	Gov't	-
47.	Farmer Water User Main Association (IP3A)	Vice-Chairperson	Belitang Jaya, East Ogan Komering Ulu Regency	Member	Non-Gov't	✔
48.	Commission of Agricultural Extension, Fishery, and Partnership	Chairperson	-	Member	Non-Gov't	✔
49.	National Outstanding Farmers and Fishermen Association	Vice-Chairperson	Ogan Komering Ilir Regency	Member	Non-Gov't	✔
50.	National Outstanding Farmers and Fishermen Association	Vice-Chairperson	Banyuasin Regency	Member	Non-Gov't	✔
51.	Independent Institution for Development Monitoring of South Sumatra	Chairperson	South Sumatra	Member	Non-Gov't	✔
52.	Foundation of Innovation Development Organization of the Prosperous and Independent Society	Chairperson	-	Member	Non-Gov't	✔
53.	Solidarity Society Forum for South Sumatra	Chairperson	South Sumatra	Member	Non-Gov't	✔
54.	Maritime and Fisheries Community Care NGO for South Sumatra Prov.	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
55.	National Outstanding Farmers and Fishermen Association	Chairperson	Lubuklinggau City	Member	Non-Gov't	✔
56.	National Outstanding Farmers and Fishermen Association	Secretary	Musi Banyuasin Regency	Member	Non-Gov't	✔
57.	National Outstanding Farmers and Fishermen Association	Chairperson	East Ogan Komering Ulu Regency	Member	Non-Gov't	✔
58.	National Outstanding Farmers and Fishermen Association	Chairperson	Lahat Regency	Member	Non-Gov't	✔
59.	National Outstanding Farmers and Fishermen Association	Chairperson	Pagaralam City	Member	Non-Gov't	✔
60.	National Outstanding Farmers and Fishermen Association	Chairperson	Ogan Ilir Regency	Member	Non-Gov't	✔
61.	National Outstanding Farmers and Fishermen Association	Chairperson	Musi Rawas Regency	Member	Non-Gov't	✔
62.	PDAM Tirta Musi Palembang	Managing Director	-	Member	Non-Gov't	✔
63.	National Outstanding Farmers and Fishermen Association	Vice-Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
64.	Indonesian Farmer Harmony Association	Chairperson	Ogan Ilir Regency	Member	Non-Gov't	✔
65.	Mutiara Madani Institute of South Sumatra Prov.	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
66.	Foundation of Village and Farmer Care Community	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
67.	Indonesian Forum for the Environment	Secretary	Bengkulu Prov.	Member	Non-Gov't	✔

No.	NAME/WORK UNIT/POSITION/ASSOCIATION	Job Title	Jurisdiction/ Place of Interest	Status in TKPSDA	Type of Organization	Attended on Nov. 1, 2018
68.	Maritime Affairs of Dian Bangsa	Assistant	South Sumatra Prov.	Member	Non-Gov't	✔
69.	Indonesian Forum for the Environment	Chairperson	Jambi Prov.	Member	Non-Gov't	✔
70.	Indonesian Forum for the Environment	Advocacy Manager	South Sumatra Prov.	Member	Non-Gov't	✔
71.	Indonesian Forum for the Environment	Advocacy & Campaign Manager	Lampung Prov.	Member	Non-Gov't	✔
72.	Indonesia Sriwijaya Tourism Foundation	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
73.	Coordination Forum for Watershed Management	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
74.	Environmental Oversight and Savior Forum NGO for South Sumatra	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
75.	Forest Care Community NGO	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
76.	Environmental Oversight NGO	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
77.	National Institution (INTAN)	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
78.	Farmer Water User Association (P3A) Rukun Makmur	Chairperson	Banyuasin Regency	Member	Non-Gov't	✔
79.	Farmer Water User Association (P3A) Sri Makmur Delta Telang	Chairperson	Banyuasin Regency	Member	Non-Gov't	✔
80.	Farmer Water User Association (P3A) of Karya Tirta	Chairperson	Banyuasin Regency	Member	Non-Gov't	✔
81.	Pinang Sebatang (Pinse) Foundation NGO	Chairperson	Jambi Prov.	Member	Non-Gov't	✔
82.	Agriculture, Livestock, Plantation and Forestry Sectors for Indonesian Farmer Harmony Association (HKTI)	Coordinator	South Sumatra Prov.	Member	Non-Gov't	✔
83.	Indonesian Farmer Harmony Association (HKTI)	Secretary	East Ogan Komering Ulu Regency	Member	Non-Gov't	✔
84.	the Coordination Forum for Watershed Management	Vice Secretary	Lampung Prov.	Member	Non-Gov't	✔
85.	Indonesian Farmer Harmony Association (HKTI)	Executive Board Secretary	Banyuasin Regency	Member	Non-Gov't	✔
86.	Regional Executive Board for the Performance Assistance Community	Vice-Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
87.	Indonesian Association of Electrical Contractor and Mechanical (AKLI)	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✔
88.	GP3A of Tri Makmur for Madang Village, Sumber Harta Sub-District, Lakitan Irrigation Area, Lubuklinggau City	Secretary	Lubuklinggau City	Member	Non-Gov't	✔
89.	GP3A of Tri Tunggal Harapan Jaya for Tebing Suluh Village, Lempuing Sub-District, Ogan Komering Ilir Regency	Chairperson	Ogan Komering Ilir Regency	Member	Non-Gov't	✔
90.	GP3A of Tirta Galuh Wangi for Karang Endah Village,	Chairperson	East Ogan Komering Ulu Regency	Member	Non-Gov't	✔
91.	Indonesian Farmer Harmony Association (HKTI)	Vice Treasurer	Musi Rawas Regency	Member	Non-Gov't	✔
92.	GP3A of Beci for Nawangsari Village, Kelingi Tugumulyo Irrigation Area, Musi Rawas Regency	Secretary	Musi Rawas Regency	Member	Non-Gov't	✔

Source: JICA Project Team 2

J2.1.2 The Second Stakeholder Meeting

The details of the meeting are described below.

Date: 19st Feb. 2019 (Tue.) 13:00 – 17:00

Place: The Conference Hall of BBWS-S.VIII, Palembang

Attendance: Refer to attached

Proceedings

After a welcome speech of Director of BBWS S.VIII Mr. Birendrajana, JICA Project Team 2, Mr. Katayama and Mr. Yamazaki, explained the followings.

- Outline of SEA
- Outline of the Project
- Assessment of Climate Change Impact
- Conceivable Adaptation Measures
- Method of impact assessment for the adaptation measures
- Next SEA meeting schedule and the participants

There were comments and questions as follows.

Qs1 (Mr. Yamin): Regarding the impact on global climate change issues, one of the major causes of climate change is deforestation and changes in land use, especially oil palm plantation, which is one of the main industries in the South Sumatra. The more greenhouse gases increase, the more likely climate change impacts will be accelerated, and it will cause droughts and floods eventually. Is the JICA Project Team 2 researching or analyzing the consequences of deforestation and changes in land use, especially oil palm plantation in South Sumatra that result in climate change?

As1 (Mr. Katayama): Yes, we considered changes in the land uses including a plantation. So, based on the spatial plan by BAPPEDA, we estimated the land use in 2050; then, based on this future land use pattern, Team-1 conducted runoff analysis for the river discharge, and we (Team 2) analyzed the impact of the future climate change by using the river discharge that Team 1 provided.

Qs2 (Mr. Suparman):

1. According to the analysis of the JICA Project Team 2, what are the most important factors that influence climate change in Indonesia and South Sumatra in particular?
2. How is the comparison of rivers in Japan and Indonesia related to waste management, so that rivers in Indonesia can be clean and beautiful and have an impact on

increasing tourism, especially river tourism in the Musi River? I want the JICA team to share information about river management in Japan.

As2 (Mr. Katayama):

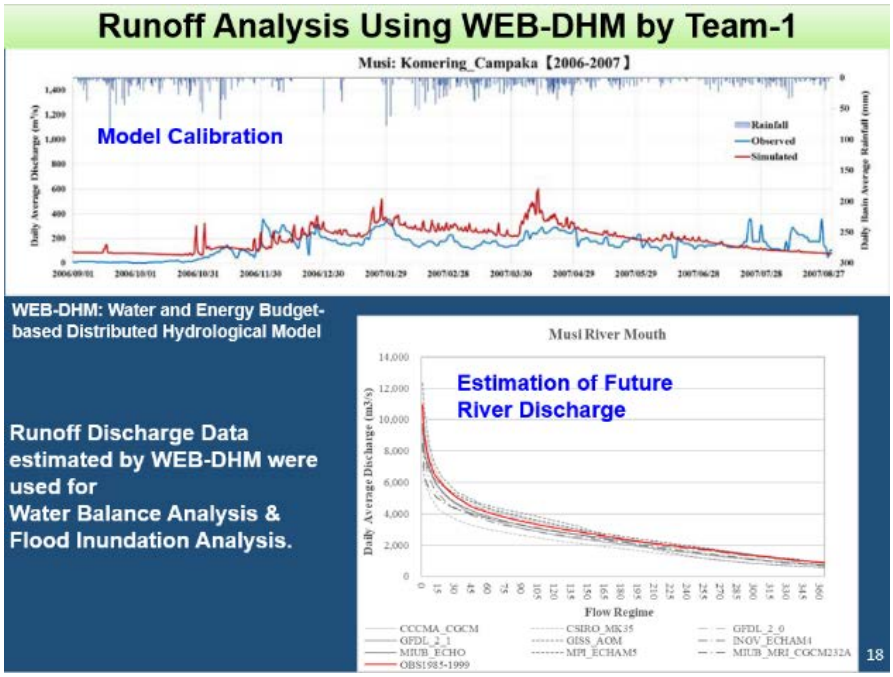
1. This question might be answered by Team 1 as they analyze climate change phenomena, and I think I'm not in the right position to answer this question.
2. In the case of Japan, we classify rivers into three classifications, such as: large, medium, and small rivers and the administrator is appointed for every river. The National government is responsible for the large river, the Provincial Government for the medium river, and the city government is responsible for a small river. Moreover, the administrator should take responsibility for water, environment, etc.; the management on river management is practiced in a strict manner.

Qs3 (Mrs. Erna): Regarding the parameters for the model of water balance analysis, did you include water damage in terms of water quality? It's because, in my opinion, we should consider water quality to analyze water balance in the future.

As3 (Mr. Sakai): We (Team 2) do not consider water quality in the water balance model. This model only considers the water quantity comparing river discharge, water demand, and river maintenance flow. As you suggested, water quality is an important factor in terms of water utilization. However, it would be a matter of priority. In my opinion, the quality of the Musi River is good enough for water use so far, while water shortage is an ongoing big issue in the river basin. Therefore, we should focus on water balance in quantity at first, and we should take water quality into account in the future.

Qs4 (Mr. Hermanto):

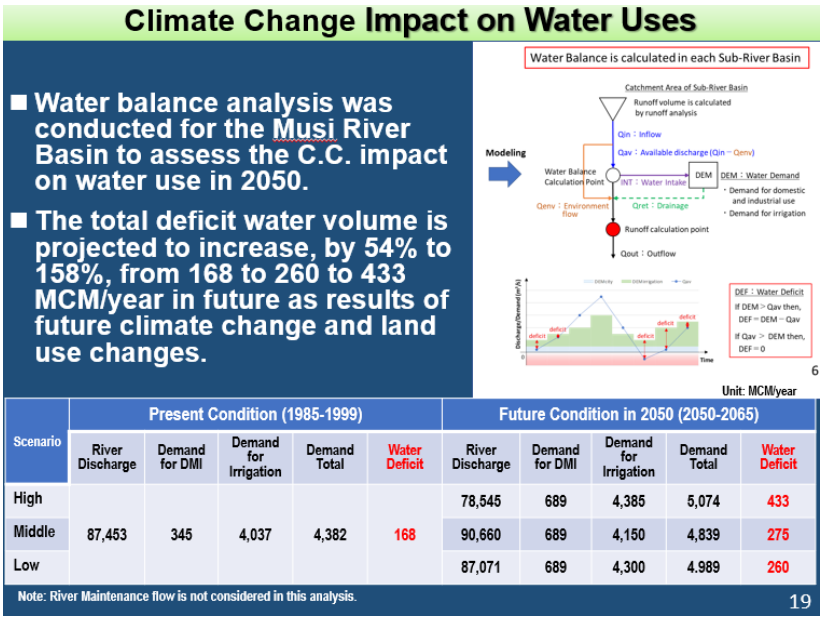
- Please provide the results of Team 1 analysis for the 3rd SEA meeting for the data validity purpose.



Source: JICA Project Team 2

Figure J2.1.1 Runoff Analysis by JICA Team 1 (Slide #18)

- Please explain why there is a difference between the observation and simulation in the Slide-18.
- Regarding slide 19, please mention (later in the next report or presentation) what kind of climate change impact that will happen in 10 or 15 years, and what number of total volume water deficit for 10 or 15 years' time.
- What's the source of the Muara Lintang dam plan?



Scenario	Present Condition (1985-1999)					Future Condition in 2050 (2050-2065)				
	River Discharge	Demand for DMI	Demand for Irrigation	Demand Total	Water Deficit	River Discharge	Demand for DMI	Demand for Irrigation	Demand Total	Water Deficit
High	87,453	345	4,037	4,382	168	78,545	689	4,385	5,074	433
Middle						90,660	689	4,150	4,839	275
Low						87,071	689	4,300	4.989	260

Source: JICA Project Team 2

Figure J2.1.2 Impact on Water Uses (Slide 19)

As4 (Mr. Katayama):

- Some models of Team 1 were revised and modified after the submission of the final report of Team 1. So, we will present the revised results of Team 1 in the Progress Report-5.
- This happened because of the lack of/limited of the available data. Team 1 made the best effort to improve the model accuracy under the constraints of data. Further improvement is impossible.

(Mr. Yamazaki)

- We got the information about Muara Lintang dam development from RENCANA 2017.

Qs5 (Mr. Mawardi):

- Why Lemau River Basin is not included in the project area? There is a hydropower plant in Lemau River basin.
- It will be better if you show and share the data collected, so we can correct and clarify.
- Please describe the specific deficit of water volume in the future. Data on water deficit in every year until 2050 is helpful for preparation for the climate change impact.
- Please provide the sedimentation deposit in every sub-river basin together with the total sedimentation for the Musi River basin, if possible.

Qs6 (Mr. Katayama):

Yes, we considered in the water balance analysis the trans-basin water transmission from the Musi River to the Lemau River for the hydropower plant (PLTA Musi).

Qs7 (Mr. Kamlan): Did you consider the issue in Ranau Lake and the Komering irrigation area? This may become a national strategic issue in water resources management. Recommendations from JICA is appreciated.

As7 (Mr. Katayama): Yes, we are focusing on that issue. Now, we are analyzing the discharge and water release from Ranau Lake regulating facility and we hope that some changes in operation rule will give more water supply to the downstream area.

Attendants from TKPSDA

【Water Resources Conservation Commission】

1.	**Kamlan Jamseri, MS** Chairperson of the Foundation of Village and Farmer Care Community for South Sumatra Province	Chairperson
2.	**Suparman, SP** Chairperson of Agriculture and Fishery Extension and Partnership Commission (South Ogan Komering Ulu Regency)	Vice-Chairperson
3.	**Ir. Erna Yuliawati, MT., Ph.D** Chairperson of the Foundation of Innovation Development Organization of the Prosperous and Independent Society	Secretary

【Water Resources Utilization Commission】

1.	**Ir. Muhammad Yamin, MM** Chairperson of Maritime and Fisheries Community Care NGO for South Sumatra Province	Chairperson
2.	**Subairi** Coordinator of Agriculture, Animal Husbandry, Plantation, and Forestry Sectors of Indonesian Farmer Harmony Association for South Sumatra Province	Vice-Chairperson
3.	**Intan Khairani** General Chairperson of Environmental Oversight NGO for South Sumatra Province	Secretary

【Water Damage Control Commission】

1.	**Hermanto, M.Si** Chairperson of National Outstanding Farmers and Fishermen Association for Lubuklinggau City	Chairperson
2.	**Tabrani Malian, S.Sos** General Chairperson of National Institution (INTAN) for South Sumatra Province	Vice-Chairperson
3.	**Deni Arian Nando** S.I.P Advocacy Manager of Indonesian Forum for the Environment (WALHI) for South Sumatra Province	Secretary

Attendants from BBWS S. VIII

Ir. Birendrajana, MT	Head of BBWS-S8
Mr. Medy Ramadhan	Head of Operation and Maintenance
Ir. Mawardi, MT	Engineering Staff of BBWS-S8

Attendants from JICA Project Team 2

Mr. Katayama, Masami (Water Resources Management/River Management/Flood Control)

Mr. Sakai, Hirokazu (Hydrology2/Water Resources Management for Musi R.B.)

Mr. Yamazaki, Norikazu (Strategic Environment Assessment, Natural and Social Environment)

Mr. Nasution, Irwinsyah (National Staff)

Ms. Purwandini, Gustiningdiah (ditto)

Source: JICA Project Team 2

Photo-J2.1.3 Welcome speech is given by the Director of BBWS S-VIII

Source: JICA Project Team 2

Photo-J2.1.4 Representatives from TKPSDA and officials of BBWS-S.VIII

J2.1.3 The Third Stakeholder Meeting

The details of the meeting are described below.

Date: 25th April. 2019 (Tue.) 19:20 – 20:40

Place: The Conference Hall of Horison Ultima Hotel

Attendance: Refer to attached

Proceedings

The meeting was held after the dinner break at 19.20. The meeting was moderated by Mr. Ir. Kamlan Jamseri M.S. After the meeting was opened by the moderator, JICA Project Team 2, Mr. Masami Katayama and Mr. Norikazu Yamazaki explained the following.

- Outline of the Project
- Assessment of climate change impact
- Conceivable adaptation measures
- Method of impact assessment for the adaptation measures
- Environmental and social impacts of selected structural measures

There were comments and questions as follows.

Qs1 (Mr. Deni): We are preparing for climate change in the future. Is there any recommendation regarding the mitigation plan for water resources management? Changes in land-use patterns by industrial projects are aggravating impacts of climate change, especially the palm oil industry located in OKI Regency. This Industry could be a cause of 8,000 ha flood in the cultivation area. I hope that there are recommendations for delaying climate change impact brought by changing the land use pattern.

Qs2 (Mr.): I would like to express my concern about the impacts of lowering the water level of Ranau Lake by 0.9m. Is there any other solution regarding drought issues? Is the solution being final?

C2 (Mr. Hermanto):

- All of the questions that are asked on the second SEA are answered by JICA Study Team 2.
- We also need other assessments regarding the environmental and social impact besides Ranau Lake.
- If lowering the water level of Ranau Lake, as the drought adaptation measure, is final, we should not forget the impacts of the project.
- We hope that on the final report, the other river basins beside the project area are included as additional data because Lemau River Basin is included in the water balance analysis.
- We need to assess technical terms for the translation for better understanding

Qs3 (Ms. Erna): How precisely the social and environmental impact measured for the drought solution using Ranau Lake's water?

C3 (Mr. Erik):

1. We should pay attention to the peatland in the Palembang reclamation area created by landfills.
2. We should also pay attention to the impacts of drought solutions using Ranau Lake's water for irrigation use.
3. The biggest tributary to Ranau lake is the Warkuk River, and it flows into the lake at Kotabatu. If the water level of Ranau Lake decreases, erosion of river banks of Warkuk River may be accelerated.

Table J2.1.3 Participants list of #3 SHM

No.	NAME/WORK UNIT/POSITION/ASSOCIATION	Job Title	Jurisdiction/ Place of Interest	Status in TKPSDA	Type of Organization	Attended
1.	Regional Development Planning Agency	Head	South Sumatra Prov.	Member (Chair)	Gov't	✓
2.	Water Resources Management Office	Head	South Sumatra Prov.	Member (Daily Chair)	Gov't	✓
3.	Balai Besar Wilayah Sungai Sumatera VIII	Head	River Region VIII	Member	Gov't	✓
4.	Food Crop and Horticulture Office	Head	South Sumatra Prov.	Member	Gov't	-
5.	Forestry Office	Head	South Sumatra Prov.	Member	Gov't	✓
6.	Environmental and Land Office	Head	South Sumatra Prov.	Member	Gov't	✓
7.	Regional Planning, Research, and Development Agency	Head	Bengkulu Prov.	Member	Gov't	-
8.	Public Works and Spatial Plan	Head	Bengkulu Prov.	Member	Gov't	✓
9.	Food Crop, Horticulture, and Plantation Office	Head	Bengkulu Prov.	Member	Gov't	-
10.	Bureau of Administration of Economic Affairs and Natural Resources	Head	Bengkulu Prov.	Member	Gov't	✓
11.	Environmental and Forestry Office	Head	Bengkulu Prov.	Member	Gov't	-
12.	Regional Development Planning Agency	Head	Jambi Prov.	Member	Gov't	-
13.	Public Works and Housing Office	Head	Jambi Prov.	Member	Gov't	-
14.	Environmental Office	Head	Jambi Prov.	Member	Gov't	✓
15.	Forestry Office	Head	Jambi Prov.	Member	Gov't	-
16.	Bureau of the Development and Cooperation of Regional Secretariat	Head	Jambi Prov.	Member	Gov't	-
17.	Regional Development Planning Agency	Head	Lampung Prov.	Member	Gov't	-
18.	Human Settlements and Water Resources Management Office	Head	Lampung Prov.	Member	Gov't	-
19.	Environmental Office of	Head	Lampung Prov.	Member	Gov't	-
20.	Forestry Office	Head	Lampung Prov.	Member	Gov't	-
21.	Regional Development Planning Agency	Head	West Lampung Regency	Member	Gov't	✓
22.	Public Works and Spatial Plan Office	Head	Palembang City	Member	Gov't	-
23.	Public Works and Spatial Plan Office	Head	Banyuasin Regency	Member	Gov't	-
24.	Environmental Office	Head	Musi Banyuasin Regency	Member	Gov't	-
25.	Public Works and Spatial Plan Office	Head	Ogan Ilir Regency	Member	Gov't	✓
26.	Public Works and Spatial Plan Office	Head	Ogan Komering Ilir Regency	Member	Gov't	-
27.	Public Works and Spatial Plan Office	Head	Prabumulih City	Member	Gov't	✓
28.	Public Works and Spatial Plan Office	Head	Muara Enim Regency	Member	Gov't	-
29.	Public Works and Spatial Plan Office	Head	Lahat Regency	Member	Gov't	✓
30.	Public Works and Spatial Plan Office	Head	East OKU Regency	Member	Gov't	-
31.	Public Works and Housing Office	Head	Ogan Komering Ulu Regency	Member	Gov't	-
32.	Public Works and Spatial Plan Office	Head	South OKU Regency	Member	Gov't	✓
33.	Public Works and Spatial Plan Office	Head	Empat Lawang Regency	Member	Gov't	✓
34.	Public Works Office of Human Settlement, Spatial Plan and Irrigation	Head	Musi Rawas Regency	Member	Gov't	-
35.	Public Works and Spatial Plan Office	Head	Lubuklinggau City	Member	Gov't	-
36.	Public Works and Spatial Plan, Housing and Settlement Area Office	Head	Rejang Lebong Regency	Member	Gov't	✓
37.	Public Works Office	Head	Kepahiang Regency	Member	Gov't	-

No.	NAME/WORK UNIT/POSITION/ASSOCIATION	Job Title	Jurisdiction/ Place of Interest	Status in TKPSDA	Type of Organization	Attended
38.	Public Works and Spatial Plan Office	Head	Central Bengkulu Regency	Member	Gov't	-
39.	Public Works and Housing Office	Head	West Lampung Regency	Member	Gov't	✓
40.	Public Works and Spatial Plan Office	Head	Pagaralam City	Member	Gov't	-
41.	Public Works and Spatial Plan Office	Head	Sarolangun Regency	Member	Gov't	-
42.	Public Works and Spatial Plan Office	Head	Muaro Jambi Regency	Member	Gov't	✓
43.	Public Works and Spatial Plan Office	Head	Batang Hari Regency	Member	Gov't	✓
44.	Public Works and Spatial Plan Office	Head	East Tanjung Jabung Regency	Member	Gov't	-
45.	Regional Agency for Disaster Management	Head	North Musi Rawas Regency	Member	Gov't	-
46.	Public Works Office	Head	Penukal Abab Lematang Ilir (PALI) Regency	Member	Gov't	✓
47.	Farmer Water User Main Association (IP3A)	Vice Chairperson	Belitang Jaya, East Ogan Komering Ulu Regency	Member	Non-Gov't	✓
48.	Commission of Agricultural Extension	Chairperson	East OKU Regency	Member	Non-Gov't	✓
49.	National Outstanding Farmers and Fishermen Association	Member	Ogan Komering Ilir Regency	Member	Non-Gov't	✓
50.	National Outstanding Farmers and Fishermen Association	Vice Chairperson	Banyuasin Regency	Member	Non-Gov't	✓
51.	Independent Institution for Development Monitoring	Chairperson	South Sumatra	Member	Non-Gov't	✓
52.	Foundation of Innovation Development Organization of the Prosperous and Independent Society	Chairperson	Palembang City	Member	Non-Gov't	✓
53.	Solidarity Society Forum for South Sumatra	Chairperson	South Sumatra	Member	Non-Gov't	✓
54.	Maritime and Fisheries Community Care NGO	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
55.	National Outstanding Farmers and Fishermen Association	Chairperson	Lubuklinggau City	Member	Non-Gov't	✓
56.	National Outstanding Farmers and Fishermen Association	Secretary	Musi Banyuasin Regency	Member	Non-Gov't	✓
57.	National Outstanding Farmers and Fishermen Association	Chairperson	East Ogan Komering Ulu Regency	Member	Non-Gov't	✓
58.	National Outstanding Farmers and Fishermen Association	Chairperson	Lahat Regency	Member	Non-Gov't	✓
59.	National Outstanding Farmers and Fishermen Association	Chairperson	Pagaralam City	Member	Non-Gov't	✓
60.	National Outstanding Farmers and Fishermen Association	Chairperson	Ogan Ilir Regency	Member	Non-Gov't	✓
61.	National Outstanding Farmers and Fishermen Association	Chairperson	Musi Rawas Regency	Member	Non-Gov't	✓
62.	PDAM Tirta Musi	Managing Director	Palembang City	Member	Non-Gov't	✓
63.	National Outstanding Farmers and Fishermen Association	Vice-Chairperson	South Sumatra Prov.	Member	Non-Gov't	-
64.	Indonesian Farmer Harmony Association	Chairperson	Ogan Ilir Regency	Member	Non-Gov't	✓
65.	Mutiara Madani Institute of South Sumatra Prov.	Chairperson	South Sumatra Prov.	Member	Non-Gov't	-
66.	Foundation of Village and Farmer Care Community	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
67.	Program and Database Development Department of the Indonesian Forum for the Environment	Chief	Bengkulu Prov.	Member	Non-Gov't	✓
68.	Maritime Affairs of Dian Bangsa	Assistant	South Sumatra Prov.	Member	Non-Gov't	✓
69.	Indonesian Forum for the Environment	Chairperson	Jambi Prov.	Member	Non-Gov't	-

No.	NAME/WORK UNIT/POSITION/ASSOCIATION	Job Title	Jurisdiction/ Place of Interest	Status in TKPSDA	Type of Organization	Attended
70.	Indonesian Forum for the Environment	Advocacy Manager	South Sumatra Prov.	Member	Non-Gov't	✓
71.	Indonesian Forum for the Environment	Advocacy and Campaign Manager	Lampung Prov.	Member	Non-Gov't	✓
72.	Indonesia Sriwijaya Tourism Foundation	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
73.	Coordination Forum for Watershed Management	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
74.	Environmental Oversight and Savior Forum NGO for South Sumatra	Chairperson	South Sumatra Prov.	Member	Non-Gov't	-
75.	Forest Care Community NGO	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
76.	Environmental Oversight NGO	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
77.	National Institution (INTAN)	Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
78.	Farmer Water User Association (P3A) Rukun Makmur	Chairperson	Banyuasin Regency	Member	Non-Gov't	✓
79.	Farmer Water User Association (P3A) Sri Makmur, MuaraTelang	Chairperson	Banyuasin Regency	Member	Non-Gov't	✓
80.	Farmer Water User Association (P3A) of Karya Tirta	Chairperson	Banyuasin Regency	Member	Non-Gov't	✓
81.	Pinang Sebatang (Pinse) Foundation NGO	Chairperson	Jambi Prov.	Member	Non-Gov't	✓
82.	Agriculture, Livestock, Plantation and Forestry Sectors for Indonesian Farmer Harmony Association (HKTI)	Coordinator	South Sumatra Prov.	Member	Non-Gov't	✓
83.	Indonesian Farmer Harmony Association (HKTI)	Secretary	East Ogan Komering Ulu Regency	Member	Non-Gov't	✓
84.	the Coordination Forum for Watershed Management	Vice Secretary	Lampung Prov.	Member	Non-Gov't	✓
85.	Indonesian Farmer Harmony Association (HKTI)	Executive Board Secretary	Banyuasin Regency	Member	Non-Gov't	✓
86.	Regional Executive Board for the Performance Assistance Community	Vice-Chairperson	South Sumatra Prov.	Member	Non-Gov't	✓
87.	Indonesian Association of Electrical Contractor and Mechanical (AKLI)	Chairperson	South Sumatra Prov.	Member	Non-Gov't	-
88.	GP3A of Tri Makmur for Madang Village, Sumber Harta Sub-District, Lakitan Irrigation Area, Lubuklinggau City	Secretary	Lubuklinggau City	Member	Non-Gov't	✓
89.	GP3A of Tri Tunggal Harapan Jaya for Tebing Suluh Village, Lempuing Sub-District, Ogan Komering Ilir Regency	Chairperson	Ogan Komering Ilir Regency	Member	Non-Gov't	✓
90.	GP3A of Tirta Galuh Wangi for Karang Endah Village,	Chairperson	East Ogan Komering Ulu Regency	Member	Non-Gov't	✓
91.	Indonesian Farmer Harmony Association (HKTI)	Vice Treasurer	Musi Rawas Regency	Member	Non-Gov't	✓
92.	GP3A of Beci for Nawangsari Village, Kelingi Tugumulyo Irrigation Area, Musi Rawas Regency	Secretary	Musi Rawas Regency	Member	Non-Gov't	✓

Source: JICA Project Team 2

Source: JICA Project Team 2

Photo-J2.1.5 Presentation given by JICA Team 2

Source: JICA Project Team 2

Photo-J2.1.6 Representatives from TKPSDA and officials of BBWS-S.VIII

Supporting Report K
IMPLEMENTATION PLAN AND COST ESTIMATE

Abbreviations

	Indonesia	English
BBWS	Balai Besar Wilayah Sungai	Large River Basin Organization
BPS	Badan Pusat Statiks	Central Bureau of Statistics
DD	-	Detail Design
DMI	-	Domestic, Municipal and Industrial
FS	-	Feasibility Study
MLIT	-	Ministry of Land, Infrastructure and Transport and Tourism, Japan
NRW	-	Non-Revenue Water
OM	-	Operation and Maintenance
PDAM	Perusahaan Daerah Air Minum	Indonesian Regional Water Utility Company
VAT	Value -Added Tax	Value -Added Tax

The Republic of Indonesia

THE PROJECT
FOR
ASSESSING AND INTEGRATING CLIMATE CHANGE IMPACTS INTO THE WATER RESOURCE:S MANAGEMENT PLANS FOR BRANTAS AND MUSI RIVER BASINS
(WATER RESOURCES MANAGEMENT PLAN)

FINAL REPORT

Supporting Report K : IMPLEMENTATION PLAN AND COST ESTIMATE

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PART 1 BRANTAS RIVER BASIN

CHAPTER K1 PRELIMINARY COST ESTIMATION

K1.1 Construction Cost of Dikes (for Flood Risk)

Construction and raising of dikes will be implemented as adaptation measures against rainstorms and floods. A construction cost curve of dike is created by a cost simulation using basic unit costs of an existing project report.

K1.1.1 Procedures of Preparation of Construction Cost Curve of Dike

The construction cost curve of dikes was prepared through a cost estimate simulation for the Widas, Brangkal, Sadar, and Tawing Rivers. The procedures of the creation of the curve is as follows:

Procedures of creating the cost curve

Creating a table regarding the dike height of the target river and the construction quantity of earth fill, sod facing, stripping and surface coarse per m of length.

1) Set dike heights for different flood scales, and calculate the quantity per m of length for each work type from the table created in the above.
2) Multiply the quantity per m of length by the construction unit price to obtain the construction unit price per m of length for the planned dike height.
3) Calculate the total construction cost by multiplying the calculated unit price per m of length by the length of dike.
4) Create a cost curve based on the embankment volume for each river and total construction costs.

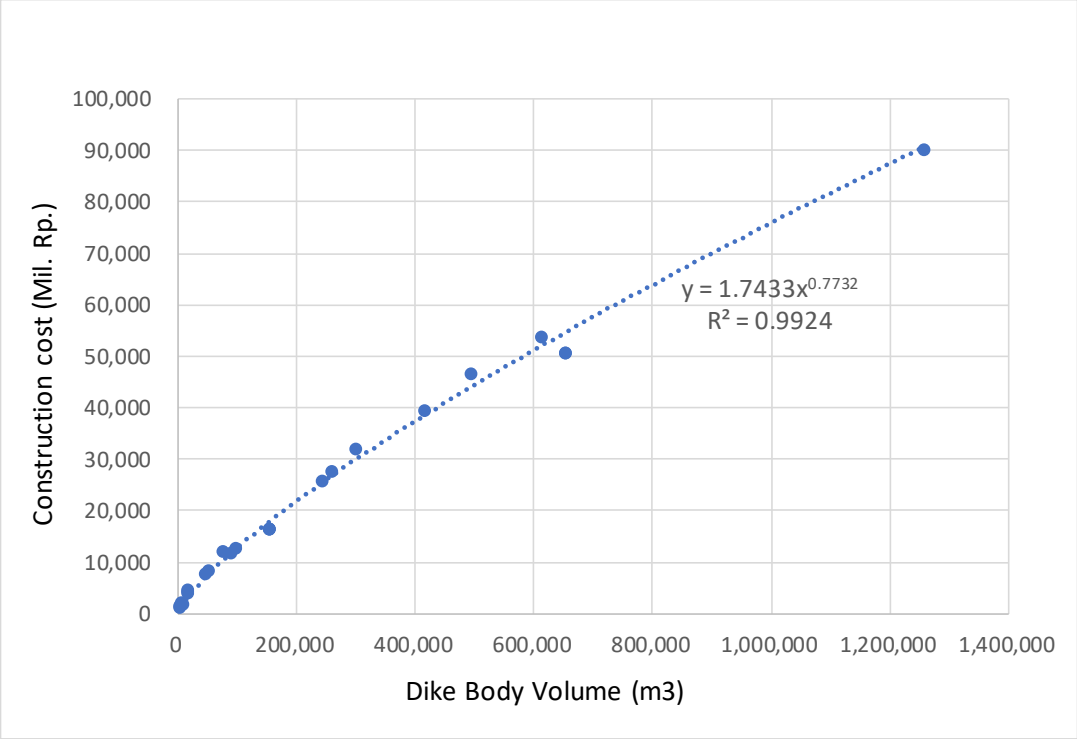
K1.1.2 Preparation of Construction Cost Curve of Dike

The simulated construction costs for the Widas River, the Brangkal River, the Sadar River, and the Tawing River are shown in Table K1.1.1, and the cost curve is shown in Figure K1.1.1.

Table K1.1.1 Dike Body Volume and Construction Cost of Each River

The Widas River,		The Brangkal River,		The Sadar River		The Tawing River	
Volume (m^3)	Cost (Mil. Rp.)	Volume (m^3)	Cost (Mil. Rp.)	Volume (m^3)	Cost (Mil. Rp.)	Volume (m^3)	Cost (Mil. Rp.)
12,000	1,869	49,500	7,708	4,570	1,024	156,100	16,436
54,000	8,409	91,840	11,639	6,451	1,445	156,100	16,436
78,000	12,146	100,800	12,775	8,702	1,950	156,100	16,436
245,000	25,796	262,500	27,638	18,346	4,110	656,208	50,758
419,900	39,457	303,100	31,913	19,051	4,268	656,208	50,758
616,640	53,668	496,964	46,698	20,328	4,554	1260,000	90,221

Source: JICA Project Team 2



Source: JICA Project Team 2

Figure K1.1.1 Curve of Dike Body Volume and Construction Cost

Basic unit cost used in the simulation is given in Table K1.1.2 and details of the cost simulation are also presented in Tables K1.1.3 through K1.1.6.

Table K1.1.2 Basic Unit Cost of Construction Item

Item	Unit	Unit Cost (Rp.)
Earth filling	m^3	51,175
Sod Facing	m^2	4,607
Stripping	m^2	4,932
Surface Coarse	m^3	127,290

Source: The report on "Lower Solo River Improvement Project (II)", 2011

Table K1.1.3 Cost of Construction of the Dike (the Widas River)

No.	Item / Hazard Scale	Unit	Unit Cost	Present	Future Climate Change Scenario (2050)					
				50-year flood	2-yr flood	5-yr flood	10-yr flood	30-yr flood	50-yr flood	100-yr flood
	Design Discharge of Widas RIver				407 m3/s	565 m3/s	665 m3/s	806 m3/s	1,006 m3/s	1,220 m3/s
1	Construction of New Dike									
	1-2 Widas River									
	Total length of new dike	m			4,000	18,000	26,000	35,000	42,500	47,000
	Average height of new dike	m			0.60	0.70	0.80	1.00	1.30	1.60
	<Quantity / meter>									
	Earthfill	m3	51,175		3.00	3.00	3.00	7.00	9.88	13.12
	Sod Facing	m2	4,607		2.24	2.24	2.24	4.48	5.82	7.16
	Stripping	m2	4,932		7.00	7.00	7.00	9.00	10.20	11.40
	Surface Coarse	m3	127,290		1.50	1.50	1.50	1.50	1.50	1.50
	Others (20% of above)	LS		0	1	1	1	1	1	1
	Unit Price of New Dike	***Rp/m***		***0***	***467,164***	***467,164***	***467,164***	***737,025***	***928,396***	***1,141,874***
	Cost of New Dike	***Mil.Rp***		***0***	***1,869***	***8,409***	***12,146***	***25,796***	***39,457***	***53,668***
	Earthfill	***m3***			***12,000***	***54,000***	***78,000***	***245,000***	***419,900***	***616,640***

Source: JICA Project Team 2

Table K1.1.4 Cost of Construction of the Dike (the Brangkal River)

No.	Item	Unit	Unit Cost	Present	Future Climate Change Scenario (2050)					
	Hazard Scale			50-year flood	2-yr flood	5-yr flood	10-yr flood	30-yr flood	50-yr flood	100-yr flood
	Design Discharge of Brangkal RIver				600 m3/s	759 m3/s	910 m3/s	1,228 m3/s	1,457 m3/s	1,832 m3/s
2	Construction of New Dike									
	2-2 Brangkal River									
	Total length of new dike	m			16,500	20,500	22,500	37,500	43,300	50,300
	Average height of new dike	m			0.50	0.70	0.80	1.00	1.20	1.50
	<Quantity / meter>									
	Earthfill	m3	51,175		3.00	4.48	4.48	7.00	7.00	9.88
	Sod Facing	m2	4,607		2.24	3.14	3.14	4.48	4.48	5.82
	Stripping	m2	4,932		7.00	7.80	7.80	9.00	9.00	10.20
	Surface Coarse	m3	127,290		1.50	1.50	1.50	1.50	1.50	1.50
	Others (20% of above)	LS		0	1	1	1	1	1	1
	Unit Price of New Dike	***Rp/m***		***0***	***467,164***	***567,761***	***567,761***	***737,025***	***737,025***	***928,396***
	Cost of New Dike	***Mil.Rp***		***0***	***7,708***	***11,639***	***12,775***	***27,638***	***31,913***	***46,698***
	Earthfill	***m3***			***49,500***	***91,840***	***100,800***	***262,500***	***303,100***	***496,964***

Source: JICA Project Team 2

Table K1.1.5 Cost of Construction of the Dike (the Sadar River)

No.	Item	Unit	Unit Cost	Present	Future Climate Change Scenario (2050)					
	Hazard Scale			50-year flood	2-yr flood	5-yr flood	10-yr flood	30-yr flood	50-yr flood	100-yr flood
	Design Discharge of Sadar RIver				82 m3/s	108 m3/s	118 m3/s	161 m3/s	178 m3/s	199 m3/s
2	Construction of New Dike									
	2-4 Tawing River									
	Total length of new dike	m			2,720	3,840	5,180	10,920	11,340	12,100
	Average height of new dike	m			0.30	0.40	0.50	0.50	0.60	0.70
	<Quantity / meter>									
	Earthfill	m3	51,175		1.68	1.68	1.68	1.68	1.68	1.68
	Sod Facing	m2	4,607		1.34	1.34	1.34	1.34	1.34	1.34
	Stripping	m2	4,932		6.20	6.20	6.20	6.20	6.20	6.20
	Surface Coarse	m3	127,290		1.50	1.50	1.50	1.50	1.50	1.50
	Others (20% of above)	LS		0	1	1	1	1	1	1
	Unit Price of New Dike	***Rp/m***		***0***	***376,393***	***376,393***	***376,393***	***376,393***	***376,393***	***376,393***
	Cost of New Dike	***Mil.Rp***		***0***	***1,024***	***1,445***	***1,950***	***4,110***	***4,268***	***4,554***
	Earthfill	***m3***			***4,570***	***6,451***	***8,702***	***18,346***	***19,051***	***20,328***

Source: JICA Project Team 2

Table K1.1.6 Cost of Construction of the Dike (the Tawing River)

No.	Item	Unit	Unit Cost	Present	Future Climate Change Scenario (2050)					
	Hazard Scale			50-year flood	2-yr flood	5-yr flood	10-yr flood	30-yr flood	50-yr flood	100-yr flood
	Design Discharge of Tawing RIver				296 m3/s	296 m3/s	296 m3/s	398 m3/s	404 m3/s	602 m3/s
2	Construction of New Dike									
	2-4 Tawing River									
	Total length of new dike	m			22,300	22,300	22,300	27,900	27,900	30,000
	Average height of new dike	m			1.40	1.40	1.40	2.50	2.50	4.60
	<Quantity / meter>									
	Earthfill	m3	51,175		7.00	7.00	7.00	23.52	23.52	42.00
	Sod Facing	m2	4,607		4.48	4.48	4.48	10.74	10.74	15.66
	Stripping	m2	4,932		9.00	9.00	9.00	14.60	14.60	19.00
	Surface Coarse	m3	127,290		1.50	1.50	1.50	1.50	1.50	1.50
	Others (20% of above)	LS		0	1	1	1	1	1	1
	Unit Price of New Dike	***Rp/m***		***0***	***737,025***	***737,025***	***737,025***	***1,819,269***	***1,819,269***	***3,007,366***
	Cost of New Dike	***Mil.Rp***		***0***	***16,436***	***16,436***	***16,436***	***50,758***	***50,758***	***90,221***
	Earthfill	***m3***			***156,100***	***156,100***	***156,100***	***656,208***	***656,208***	***1,260,000***

Source: JICA Project Team 2

K1.2 Cost Estimation of Dam Plan (for Drought Risk)

K1.2.1 Preparation of Unit Construction Cost Curve

A unit construction cost curve was created by using the available cost data of the previous dam project reports with the following basic conditions and procedures.

Basic Conditions

The basic conditions for preliminary cost estimation are following.

- Construction cost means direct construction cost without tax excluding the cost of land

acquisition, compensation for affected people, site management and so on.

- Costs of hydraulic power generation are exclusive.
- Cost estimation is made with the price level of August 2017
- To convert the costs of the previous project reports to those at August 2017 by using price escalation index of BPS (Appendix-1).
- To consider construction cost index by province for the dams located in the provinces other than East Java Province (Jatibarang Dam ; Central Java) (Appendix-2)

Procedure for Drawing Unit Cost Curve

- To set unit cost of dam construction per cubic meter based on existing data of the volume of dam body and total construction costs that are available in the dam project reports.
- To convert the unit cost to the target price level (at August 2017)
- To draw the cost curve based on the converted unit costs
- To Estimate the cost of target dams

The unit cost curves of new dam construction were created based on available data of eight rockfill dams and two earth fill dams. The estimated unit construction costs for these dams are shown in Tables K1.2.1 and K1.2.2. The created unit construction curves are presented in Figure K1.2.1 for rockfill dam and in Figure K1.2.2 for Earthfill dam respectively. Detail data of these dams are also presented in Tables K1.2.3 and K1.2.4.

Table K1.2.1 Unit Cost of Direct Construction Cost (Rockfill Dam)

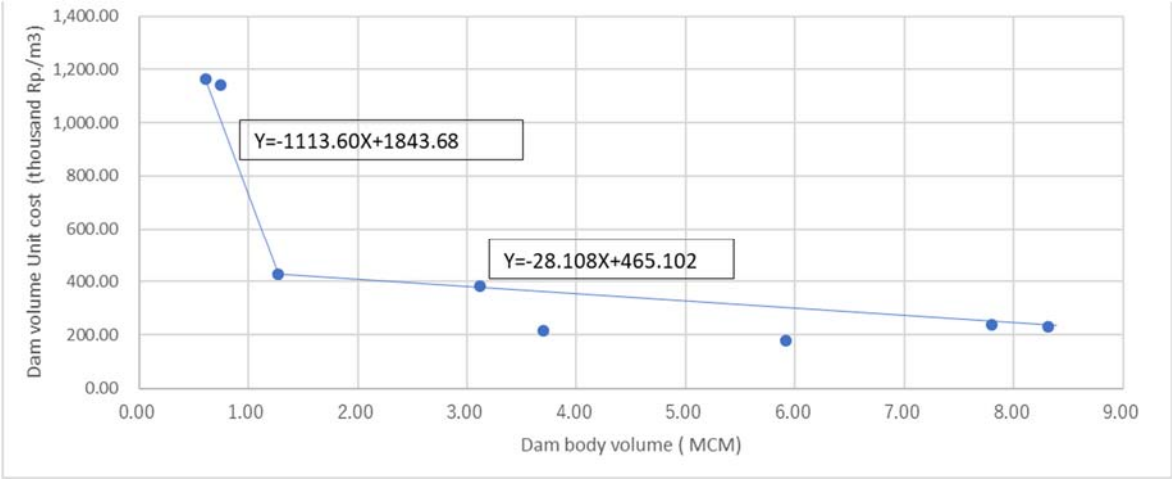
No.	Dam Name	Prov.	Vol. (10^6 m^3)	Unit Cost (Rp. $10^3/m^3$)	Coefficent*1	Unit Cost at 2017 (Rp. $10^3/m^3$)
1	Babadan	East Java	8.32	50.89	4.527	230.38
2	Genteng I	East Java	3.12	84.42	4.527	382.17
3	Kencir	East Java	5.91	123.83	1.428	176.83
4	Kampak	East Java	1.27	414.53	1.033	428.21
5	Tugu	East Java	7.80	210.16	1.125	236.43
6	Bagong	East Java	3.70	198.33	1.088	215.78
7	Bajulmati	East Java	0.75	570.17	2.003	1,142.05
8	Jatibarang	Central Java	0.61	857.62	1.357	1,163.79

Note: Coefficient is estimated from escalation from estimated year to 2017 and regional economic condition.
Escalation of base year is applied 2000 year.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).
Source: JICA Project Team 2 estimated based on data from BBWS Brantas and BBWS Pemali Juana

Table K1.2.2. Unit Cost of Direct Construction Cost (Earthfill Dam)

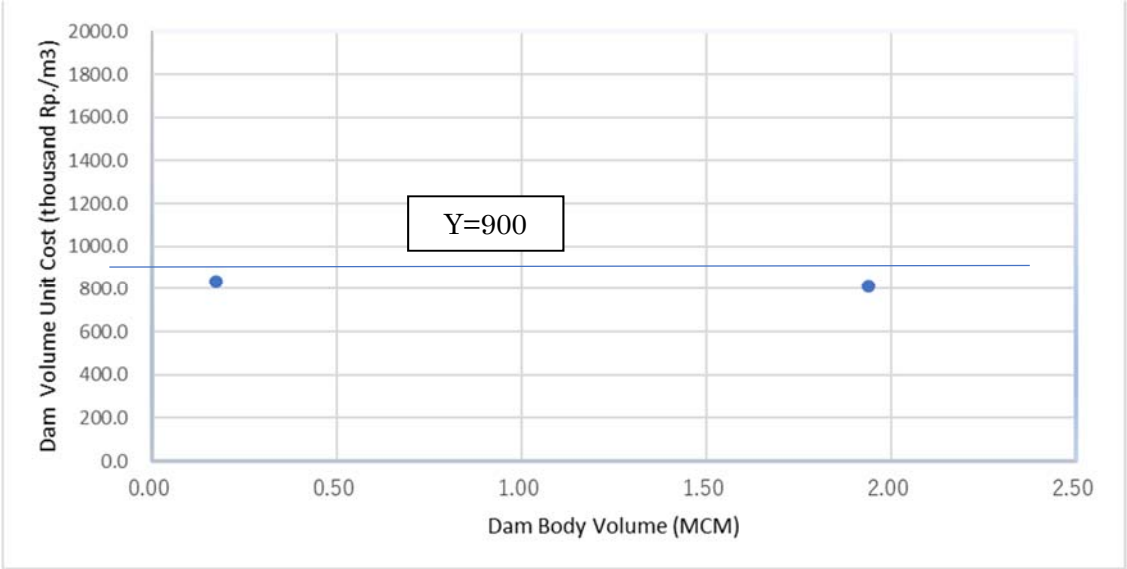
No.	Dam Name	Prov.	Vol. (10^6 m^3)	Unit Cost (Rp. $10^3/m^3$)	Coefficent*1	Unit Cost at 2017 (Rp. $10^3/m^3$)
1	Kedungwarak	East Java	0.17	323.4	2.572	831.78
2	Semantok	East Java	1.94	783.7	1.038	813.48

Note: Coefficient is estimated from escalation from estimated year to 2017 and regional economic condition.
Escalation of base year is applied 2000 year.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).
Source: JICA Project Team 2 estimated based on data from BBWS Brantas



Source: JICA Project Team 2

Figure K1.2.1 Curve of Dam Volume and Unit Cost (Rockfill Dam)



Source: JICA Project Team 2

Figure K1.2.2 Curve of Dam Volume and Unit Cost (Earthfill Dam)

Table K1.2.3 Unit Cost of Dam Construction per Cubic Meter (Unknown powerhouse cost)

No.	Name	Status	Dam				1998 MP			After 1998				Unit cost Excluding power station		Price Level year
			Type	Height (m)	Crest Width (m)	Crest Length (m)	Dam Volume (MCM)	Construction Cost (10^9Rp)*1	Unit Cost 1 (thousand Rp)	Dam Volume (MCM)	Construction Cost (10^9Rp)*1	Construction Cost (10^9Rp)*3	Unit Cost 1 (thousand Rp)	Power station ratio	Dam Construction Unit cost Excluding Power	
							b1	b2	b2/b1	c1	c2	c3	c2/c1			
8	Babadan Dam	Expected dam untl 2050 (present climate)	Rockfill	80		880	8.32	427.45	51.40	-	-	-	-	0.01	50.89	MP 1997
1	Genteng I Dam	Expected dam untl 2050 (future climate)	Rockfill	82		460	3.12	271.54	87.03	-	-	-	-	0.03	84.42	F/S Oct. 2002 (NK)
7	Kuncir Dam	Expected dam untl 2050 (present climate)	Rockfill	100		870	-	-	-	5.91	739.83	1038.71	125.08	0.01	123.83	Pre FS(?)Aug. 2008 (PTINDRAKARYA)
15	Kampak Dam	Expected dam untl 2050 (future climate)	Rockfill	70	12	316	-	-	-	1.27	542.74	636.48	427.35	0.03	414.53	FS 2016
	Bajulmati Dam		Rockfill	46.8	6	250	-	-	-	0.75	440.85	-	587.80	0.03	570.17	FS 2006/8
4	Kedungwarak Dam	Expected dam untl 2050 (present climate)	Earthfill	32		115	-	-	-	0.17	56.83	-	327.31	0.01	323.38	F/S Jul, 2005 (PT RANCANG SEMESTA NUSANTARA)

Source: JICA Project Team 2

Table K1.2.4 Unit Cost of Dam Construction per Cubic Meter (Known powerhouse cost)

No.	Name	Dam						Hydro Electric Power Plant		Project Cost 3							Contract Data
		Type	Height (m)	Length (m)	Crest Width (m)	Crest Length (m)	Embankment/Dam body Volume (thousand m3)	Installed Capacity (MW)	Annual Energy (GWh)	Project Cost 3	Power station	Supervision	Land compensation	Total (billion)	Dam Construction Unit cost Base ; Dam body volume (thousand)	Dam Construction Unit cost Excluding Power stastion Base ; Dam body volume (thousand)	Price Level year
			b	c		d	e	f		j				k	j/e	j/e	
2	Tugu Dam	Rockfill	81		12	437.27	7800	0.4	—	1657	17.73	—	15.7 (VAT INC)	620 (VAT INC)	212.44	210.16	2013/12/18
14	Bagong Dam	Rockfill	82			620	3700	0.52	—	759	25.166	—	198		205.14	198.33	2014
Center Jawa	Jatibarang Dam	Rockfill	62			807	601			544.25	18	—			905.57	875.62	2009/8
6	Semantok Dam	Earthfill	38.5		9	400	1940	1.01		1539	18.54	—	—		793.30	783.74	2015

Source: JICA Project Team 2

K1.2.2 Unit Construction Cost for Heightening of Sutami Dam

Unit costs by construction type for heightening of the Sutami Dam were estimated based on those of Tugu, Bagong, Semantok and Jatibarang Dams. The unit cost of embankment, spillway, spillway gate and gate at connecting channel are shown in Tables K1.2.5 to K1.2.8.

Table K1.2.5 Unit Cost of Direct Construction Cost (Embankment)

No.	Dam Name	Prov.	Vol. (10^6 m^3)	Cost (Rp. Mil.)	Unit Cost (Rp. $10^3/m^3$)	Coefficent*1	Unit Cost at 2017 (Rp. $10^3/m^3$)
1	Bagong	East Java	3.70	409,248	110.6	1.037	115
2	Tugu	East Java	7.80	879,532	112.8	1.125	127
Average							121

Note: Coefficient is estimated from escalation from estimated year to 2017 and regional economic condition.
Escalation of base year is applied 2000 year.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).
Source: JICA Project Team 2 estimated based on data from BBWS Brantas

Table K1.2.6 Unit Cost of Direct Construction Cost (Spillway)

No.	Dam Name		Area (m^2)	Cost (Rp. Mil.)	Unit Cost (Rp. 10^3)	Coefficent*1	Unit Cost at 2017 (Rp. 10^3)
1	Bagong	30m x 300m	9,000	194,067	21,563	1.037	22,361
2	Semantok	46.2m x 110m	5,082	124,749	24,547	1.125	27,615
Average							25,000

Note: Coefficient is estimated from escalation from estimated year to 2017 and regional economic condition.
Escalation of base year is applied 2000 year.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).
Source: JICA Project Team 2 estimated based on data from BBWS Brantas

Table K1.2.7 Unit Cost of Direct Construction Cost (Spillway Gate)

No.	Dam Name	Prov.	Width (m)	Cost (Rp. Mil.)	Unit Cost (Rp. 10^3)	Coefficent*1	Unit Cost at 2017 (Rp. 10^3)
1	Tugu	East Java	35	12,015	343,286	1.125	386,197

Note: Coefficient is estimated from escalation from estimated year to 2017 and regional economic condition.
Escalation of base year is applied 2000 year.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).
Source: JICA Project Team 2 estimated based on data from BBWS Brantas

Table K1.2.8 Unit Cost of Direct Construction Cost (Gate at Conncting Channel)

No.	Dam Name		Size	Cost (Rp. 10^3)	Unit Cost (Rp. 10^3)	Coefficent*1	Unit Cost at 2017 (Rp. 10^3)
8	Jatibarang	Flap Gate	600mm	36,852	36,852	1.357	50,008

Note: Coefficient is estimated from escalation from estimated year to 2017 and regional economic condition.
Escalation of base year is applied 2000 year.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).
Source: JICA Project Team 2 estimated based on data from BBWS Pemali Juana

K1.2.3 Project Cost Estimation

By using the above unit construction cost curves and the unit costs the project costs for the proposed seven new dams and the heightening of Sutami Dam were estimated as presented in Tables K1.2.9 and K1.2.11. A summary of the project cost of the new dam development according to the climate scenario is also given in Table K1.2.10.

It is noted that the project costs include following costs:

- Administration cost: 10% of Construction Cost
- Engineering service: 15% of Construction Cost
- Physical contingency: 6% of Construction Cost
- Price escalation: No consideration in the Project
- Compensation cost (Land acquisition and resettlement): 25% of Construction Cost
- VAT: 10%

Table K1.2.9 Construction Cost of New Dams

(Unit: Rp. Mil.)

Dam Name		Kedungwarak	Kuncir	Babadan
Dam Type		Earthfill	Rockfill	Rockfill
Embankment (10^3m^3)		216	6,850	8,300
Direct Cost	a	194,400	1,870,050	1,925,600
Compensation Cost	b=a x 0.25	48,600	467,513	481,400
Administration Cost	c=a x0.1	19,440	187,005	192,560
E/S Cost	d=a x 0.15	29,160	280,508	288,840
Price Escalation		0	0	0
Physical Contingency	e=(a+b+c+d)x0.06	17,496	168,305	173,304
Sub-total	f	309,096	2,973,381	3,061,704
VAT	g=f x 0.1	30,910	297,338	306,170
Total	f+g	340,006	3,270,719	3,367,874

Dam Name	Kont II	Genteng I	Ketandan	Kempak
Dam Type	Rockfill	Rockfill	Rockfill	Rockfill
Embankment (10^3m^3)	9,300	3,000	158	1,270
Direct Cost	1,897,200	1,143,000	263,544	544,830
Compensation Cost	474,300	285,750	65,886	136,208
Administration Cost	189,720	114,300	26,354	54,483
E/S Cost	284,580	171,450	39,532	81,725
Price Escalation	0	0	0	0
Physical Contingency	170,748	102,870	23,719	49,035
Sub-total	3,016,548	1,817,370	419,035	866,281
VAT	301,655	181,737	41,904	86,628
Total	3,318,203	1,999,107	460,939	952,909

Source: JICA Project Team 2

Table K1.2.10 Summary of Total Cost to Each Scenario

(Unit: Rp. Bil.)

New Dam	Medium	Low	High
Genteng I	1,999	-	1,999
Kempak	-	-	953
Babadan	3,368	3,368	3,368
Kont II	3,318	3,318	3,318
Kencir	3,271	-	3,271
Kedungwarak	340	340	340
Ketandan	-	-	461
Total	12,296	7,026	13,710

Note: "-" not applied as an adaptation measure
Source: JICA Project Team 2

Table K1.2.11 Project Cost of Heightening of Sutami Dam

Item	Unit	Unit Price (Rp. 10^3)	QTY	Amount (Rp. 10^6)	Remark
Heightening of main dam	m^3	121	1,198,000	144,958	H=5m
Replacement of spillway	m^2	25,000	920	23,000	460mx20m
Replacement of Spillway Gate	m	387,000	20	7,740	W=20m
Replacemen tof gate at connecting chanel	LS	50,000	1	50	600mm
Saddle Dam	m^3	121	2,250	272	H=3m
Direct Cost	a			175,748	
Compensation Cost	b=a x 0.25			43,937	
Administration Cost	c= a x 0.10			17,575	
Engineering Service	d= a x 0.15			26,362	
Price Escalation	e			0	
Physical Contingency	f=(a+b+c+d) x 0.06			3.817	
Sub-total	g			267,439	
VAT	h=g x 0.1			26,744	
Total				294,183	

Source: JICA Project Team 2

CHAPTER K2 IMPLEMENTTATION SCHDULE

K2.1 Implementation Schedule (for Flood Risk)

The flood control measures are assumed for each 3 levels of climate change.

K2.1.1 Construction of Dike

Implementation schedule is planned in consideration of working period of bulldozers for earthworks (one bulldozer in 1 km). The total construction period is assumed to be three times as long as the working period of bulldozers. The working period of bulldozers in each river and the whole construction period is shown in Table K2.1.1.and Table K2.1.2.

The conditions for estimating working terms bulldozers are assumed, as follows, referring to a cost estimate manual in Japan, MLIT:

Specs of equipment

Equipment name	Type	Note
Bulldozer	15t	Cost estimation standards of civil works (MLIT:2016)

Work efficiency (per day)

Equipment name	Work efficiency	Note
Bulldozer	385m^3/day	Cost estimation standards of civil works (MLIT:2016)

Basic condition

Items	Assumption	Note
Workable days	20 day/month	Monthly average from annual workable days in case of Jatibarang Dam
Number of working bulldozers	l one bulldozer in 1 km	
Workable period of bulldozers	one third of the whole construction period	

Table K2.1.1 Working Months of Embankment of Each Scenario

Name	Dike body volume (m3)	Length (km)	Embnakment volume per 1km (m3/km)	Working volume of bulldozer per day (m3/day)*1	Working months of embankment (month)
Medium Scenario					
Dike					
Widas River (Upper)	88,423	6.5	13,604	385	2
Widas River (Kedung & Kencir)	78,782	11.5	6,851	385	1
Widas River (Lower)	327,863	34.3	9,559	385	2
Ngotok River	332,737	43.1	7,720	385	2
Sadar River	12,608	6.8	1,854	385	1
Tawing River	420,165	26.6	15,796	385	3
Low Scenario					
Dike					
Widas River (Upper)	88,423	6.5	13,604	385	2
Widas River (Kedung & Kencir)	78,782	11.5	6,851	385	1
Widas River (Lower)	327,863	34.3	9,559	385	2
Ngotok River	90,132	43.1	2,091	385	1
Sadar River	12,608	6.8	1,854	385	1
Tawing River	323,757	26.6	12,171	385	2
High Scenario					
Dike					
Widas River (Upper)	88,423	6.5	13,604	385	2
Widas River (Kedung & Kencir)	78,782	11.5	6,851	385	1
Widas River (Lower)	327,863	34.3	9,559	385	2
Ngotok River	993,548	43.1	23,052	385	3
Sadar River	38,300	6.8	5,632	385	1
Tawing River	253,484	26.6	9,529	385	2

*1 Source: Standard cost estimate of MILT in Japan
Source: JICA Project Team 2

Table K2.1.2 Implementation Schedule of Dike of Each Scenario (bar chart)

Name	Construction term (month)*1	Embankment term (month)	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Medium Scenario																
Dike	33															
Widas River (Upper)	6	2														
Widas River (Kedung & Kencir)	3	1														
Widas River (Lower)	6	2														
Ngotok River	6	2														
Sadar River	3	1														
Tawing River	9	3														
Low Scenario																
Dike	27															
Widas River (Upper)	6	2														
Widas River (Kedung & Kencir)	3	1														
Widas River (Lower)	6	2														
Ngotok River	3	1														
Sadar River	3	1														
Tawing River	6	2														
High Scenario																
Dike	33															
Widas River (Upper)	6	2														
Widas River (Kedung & Kencir)	3	1														
Widas River (Lower)	6	2														
Ngotok River	9	3														
Sadar River	3	1														
Tawing River	6	2														

*1 ; Dike works (embankement, sod facing, stripping, surface coarse, etc.)
Construction term; Embankment term×3 (from existing construction)

Source: JICA Project Team 2

K2.2 Implementation Schedule (for Drought Risk)

K2.2.1 Construction of New Dams

The number of required new dams is dependent on the future climate scenario. The project implementation schedule is planned for each scenario, based on the following conditions, referring to a cost estimate manual in Japan, MLIT:

Basic condition

- Plan period of construction of new dam is based on how often dump trucks are able to shuttle to the dam site
- Based on the situation of the sites, the transport frequency is assumed to be 20 dump trucks per hour.
- The whole period of the project schedule is assumed to be twice as long as the construction period of dam body, referring to past experiences.

Specs of equipment

Equipment name	Type	Note
Bulldozer	21t	Cost estimation standards of civil works (MLIT)
Dump truck	10t	Cost estimation standards of civil works (MLIT)

Work efficiency (per hour)

Equipment name	Work efficiency	Note
Bulldozer	62m^3/h	Cost estimation standards of civil works (MLIT)
Dump truck	12m^3/h	Cost estimation standards of civil works (MLIT)

Basic condition

Items	Assumption	Note
Workable hours	7.5 h/day	
Workable days	20 day/month	Monthly average from annual workable days in case of Jatibarang Dam
The frequency of dump trucks shuttling to the dam site	less than 150 dump trucks per day	Assuming frequency of carry-in truck once every 3 minutes

K2.2.2 Heightening of Sutami Dam

The construction period of the heightening of Sutami Dam is assumed to be 3 years.

K2.2.3 Other Measures

The both measures of repair of tertial irrigation canals and renewal of DMI water pipes will be implemented within the period of the dam construction.

K2.2.4 Results of Implementation Schedule

Necessary amounts of equipment and their periods for the operation that were estimated based on operation efficiencies are shown as Table K2.2.1.

Following the conditions as stated in the above, the project time schedule with bar chart is proposed as shown in Table K2.2.2.

K2.3 Yearly Budget Plan of Dam Construction Cost

Based on the proposed implementation plan, yearly budget plan of the dam construction cost is also prepared for each dam as presented in Tables K2.3.1 and K2.3.2, referring to the existing dam plans.

Table K2.2.1 Number and Periods of Equipment Operation

Name	Impact case	Dam body volume (m3)	Construction term (year)	Embankment term (year)	Embnakment volume per year (m3/y)	Embnakment volume per day (m3/d)*1	Required number of dump truck per day *2	Required number of bulldozer per day *3
Impact case L			7				(10t)	(21t)
Dam								
Kedungwarak Dam	L	216,000	3.0	1.5	144,000	600	7	1
Babadan Dam	L	8,300,000	6.0	3.0	2,766,667	11,528	128	25
Konto II Dam	L	9,300,000	6.0	3.0	3,100,000	12,917	144	28
Impact case M			10				(10t)	(21t)
Dam								
Kedungwarak Dam	L	216,000	3.0	1.5	144,000	600	7	1
Babadan Dam	L	8,300,000	6.0	3.0	2,766,667	11,528	128	25
Konto II Dam	L	9,300,000	6.0	3.0	3,100,000	12,917	144	28
Kuncir Dam	M	6,850,000	5.0	2.5	2,740,000	11,417	127	25
Genteng I Dam	M	3,000,000	4.0	2.0	1,500,000	6,250	69	13
Impact case H			10				(10t)	(21t)
Dam								
Kedungwarak Dam	L	216,000	3.0	1.5	144,000	600	7	1
Babadan Dam	L	8,300,000	6.0	3.0	2,766,667	11,528	128	25
Konto II Dam	L	9,300,000	6.0	3.0	3,100,000	12,917	144	28
Kuncir Dam	M	6,850,000	5.0	2.5	2,740,000	11,417	127	25
Genteng I Dam	M	3,000,000	4.0	2.0	1,500,000	6,250	69	13
Ketandan Dam	H	158,000	3.0	1.5	105,333	439	5	1
Kampak Dam	H	1,270,000	3.0	1.5	846,667	3,528	39	8
Sutami Dam (heightning)	H	1,198,000	3.0	2.0	599,000	2,496	28	5

*1 ; 20day/month、*2 ; 12m^3/hour、*3 ; 62m^3/hour

Source: JICA Project Team 2

Table K2.2.2 Project Time Schedule (bar chart)

Name	Impact case	Construction term (year)	Embankment term (year)	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Impact case L		7															
Dam																	
Kedungwarak Dam	L	3.0	1.5														
Babadan Dam	L	6.0	3.0														
Konto II Dam	L	6.0	3.0														
Irrigation canal (tertiary) repair		7.0															
Pipe replacement initial		7.0															
Recycling plant for sewage water		7.0															
Impact case M		10															
Dam																	
Kedungwarak Dam	L	3.0	1.5														
Babadan Dam	L	6.0	3.0														
Konto II Dam	L	6.0	3.0														
Kuncir Dam	M	5.0	2.5														
Genteng I Dam	M	4.0	2.0														
Irrigation canal (tertiary) repair		10.0															
Pipe replacement initial		10.0															
Recycling plant for sewage water		10.0															
Impact case H		10															
Dam																	
Kedungwarak Dam	L	3.0	1.5														
Babadan Dam	L	6.0	3.0														
Konto II Dam	L	6.0	3.0														
Kuncir Dam	M	5.0	2.5														
Genteng I Dam	M	4.0	2.0														
Ketandan Dam	H	3.0	1.5														
Kampak Dam	H	3.0	1.5														
Sutami Dam (heightning)	H	3.0	2.0														
Irrigation Canal (tertiary) repair		10.0															
Pipe replacement initial		10.0															
Recycling plant for sewage water		10.0															

Source: JICA Project Team 2

Table K2.3.1 Budget Plan of Dam Project (1)

BUDGET PLAN

No.	Work Item	Kedungwarak Dam									
		Type	Rockfill	Dam body volume (m3)		216,000					
		Construction Cost (10^9 Rp.)			194						
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term						
					1 year		2 year		3 year		
	Preparation and access road	8%	15	0.5	15.2						
	Diversion channel and intake	11%	21	1.0		10.4	10.4				
	Main dam	60%	116	1.5		38.6	38.6	38.6			
	Spillway	19%	38	1.0				18.8	18.8		
	Others	3%	5	0.5						5.0	
					15.2	49.0	49.0	57.4	18.8	5.0	
	Total construction cost	100%	194	3.0	64.2		106.4		23.8		
	Embnakment volume per day (m3/d)*1		20day/month	600							
	Required number of dump truck per day		12m3/h(10t)	6							
	Required number of bulldozer per day		40m3/h(21t)	2							

BUDGET PLAN

No.	Work Item	Babadan Dam															
		Type	Rockfill	Dam body volume (m3)		8,300,000											
		Construction Cost (10^9 Rp.)			1,924												
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term												
					1 year		2 year		3 year		4 year		5 year		6 year		
	Preparation and access road	8%	151	1.0	75.4	75.4											
	Diversion channel and intake	11%	205	1.5		68.3	68.3	68.3									
	Main dam	60%	1,146	3.0			191.0	191.0	191.0	191.0	191.0	191.0					
	Spillway	19%	372	2.0							93.1	93.1	93.1	93.1			
	Others	3%	50	1.0											24.9	24.9	
					75.4	143.7	259.4	259.4	191.0	191.0	284.1	284.1	93.1	93.1	24.9	24.9	
	Total construction cost	100%	1,924	6.0	219.1		518.8		382.1		568.2		186.1		49.7		
	Embnakment volume per day (m3/d)*1		20day/month	11,528													
	Required number of dump truck per day		12m3/h(10t)	120													
	Required number of bulldozer per day		40m3/h(21t)	36													

BUDGET PLAN

No.	Work Item	Konto II Dam															
		Type	Rockfill	Dam body volume (m3)		9,300,000											
		Construction Cost (10^9 Rp.)			1,894												
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term												
					1 year		2 year		3 year		4 year		5 year		6 year		
	Preparation and access road	8%	148	1.0	74.2	74.2											
	Diversion channel and intake	11%	202	1.5		67.3	67.3	67.3									
	Main dam	60%	1,128	3.0			188.1	188.1	188.1	188.1	188.1	188.1					
	Spillway	19%	366	2.0							91.6	91.6	91.6	91.6			
	Others	3%	49	1.0											24.5	24.5	
					74.2	141.5	255.3	255.3	188.1	188.1	279.7	279.7	91.6	91.6	24.5	24.5	
	Total construction cost	100%	1,894	6.0	215.7		510.7		376.1		559.3		183.2		49.0		
	Embnakment volume per day (m3/d)*1		20day/month	12,917													
	Required number of dump truck per day		12m3/h(10t)	135													
	Required number of bulldozer per day		40m3/h(21t)	40													

BUDGET PLAN

No.	Work Item	Kuncir Dam													
		Type	Rockfill	Dam body volume (m3)		6,850,000									
		Construction Cost (10^9 Rp.)			1,867										
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term										
					1 year		2 year		3 year		4 year		5 year		
	Preparation and access road	8%	146	1.0	73.2	73.2									
	Diversion channel and intake	11%	199	1.5		66.3	66.3	66.3							
	Main dam	60%	1,112	2.5			222.5	222.5	222.5	222.5	222.5				
	Spillway	19%	361	1.5							120.4	120.4	120.4		
	Others	3%	48	1.0									24.1	24.1	
					73.2	139.5	288.8	288.8	222.5	222.5	342.9	120.4	144.5	24.1	
	Total construction cost	100%	1,867	5.0	212.6		577.5		444.9		463.2		168.7		
	Embnakment volume per day (m3/d)*1		20day/month	11,417											
	Required number of dump truck per day		12m3/h(10t)	119											
	Required number of bulldozer per day		40m3/h(21t)	36											

Source: JICA Project Team 2

Table K2.3.2 Budget Plan of Dam Project (2)

BUDGET PLAN

No.	Work Item	Genteng I Dam											
		Type	Rockfill	Dam body volume (m3)			3,000,000						
		Construction Cost (10^9 Rp.)			1,142								
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term								
					1 year		2 year		3 year		4 year		
	Preparation and access road	8%	90	1.0	44.8	44.8							
	Diversion channel and intake	11%	122	1.0		60.8	60.8						
	Main dam	60%	680	2.0			170.1	170.1	170.1	170.1			
	Spillway	19%	221	1.0						110.5	110.5		
	Others	3%	30	1.0							14.8	14.8	
					44.8	105.6	230.9	170.1	170.1	280.6	125.2	14.8	
	Total construction cost	100%	1,142	4.0	150.4		401.0		450.6		140.0		
	Embnakment volume per day (m3/d)*1		20day/month	6,250									
	Required number of dump truck per day		12m3/h(10t)	65									
	Required number of bulldozer per day		40m3/h(21t)	20									

BUDGET PLAN

No.	Work Item	Ketandan Dam								
		Type	Rockfill	Dam body volume (m3)			158,000			
		Construction Cost (10^9 Rp.)			264					
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term					
					1 year		2 year		3 year	
	Preparation and access road	8%	21	0.5	20.7					
	Diversion channel and intake	11%	28	1.0		14.1	14.1			
	Main dam	60%	157	1.5		52.4	52.4	52.4		
	Spillway	19%	51	1.0				25.5	25.5	
	Others	3%	7	0.5						6.8
					20.7	66.5	66.5	78.0	25.5	6.8
	Total construction cost	100%	264	3.0	87.2		144.5		32.4	
	Embnakment volume per day (m3/d)*1		20day/month	439						
	Required number of dump truck per day		12m3/h(10t)	5						
	Required number of bulldozer per day		40m3/h(21t)	1						

BUDGET PLAN

No.	Work Item	Kampak Dam								
		Type	Rockfill	Dam body volume (m3)			1,270,000			
		Construction Cost (10^9 Rp.)			545					
		Partial rate	by work (10^9 Rp)	Construction period (year)	Construcstion term					
					1 year		2 year		3 year	
	Preparation and access road	8%	43	0.5	42.7					
	Diversion channel and intake	11%	58	1.0		29.0	29.0			
	Main dam	60%	325	1.5		108.2	108.2	108.2		
	Spillway	19%	105	1.0				52.7	52.7	
	Others	3%	14	0.5						14.1
					42.7	137.3	137.3	160.9	52.7	14.1
	Total construction cost	100%	545	3.0	180.0		298.2		66.8	
	Embnakment volume per day (m3/d)*1		20day/month	3,528						
	Required number of dump truck per day		12m3/h(10t)	37						
	Required number of bulldozer per day		40m3/h(21t)	11						

BUDGET PLAN

No.	Work Item	Sutami Dam (heighting)								
		Type	Rockfill	Dam body volume (m3)			1,198,000			
		Construction Cost (10^9 Rp.)			261					
		Net cost (10^9 Rp)		Construction period (year)	Construcstion term					
					1 year		2 year		3 year	
	Widening/Heightening ofDam Body	143.8		2.0		35.9	35.9	35.9	35.9	
	Replacement of Spillway	22.1		1.0				11.0	11.0	
	Replacement of Spillway Gte	7.8		0.5						7.8
	Replacement of Gate at connecting channel	0.1		0.5	0.1					
	Saddle Dam	0.3		0.5		0.3				
					0.1	36.2	35.9	47.0	47.0	7.8
	Total construction cost	174.0		3.0	36.3		82.9		54.8	
	Embnakment volume per day (m3/d)*1		20day/month	3,328						
	Required number of dump truck per day		12m3/h(10t)	35						
	Required number of bulldozer per day		40m3/h(21t)	10						

Source: JICA Project Team 2

PART 2 MUSI RIVER BASIN

CHAPTER K3 PRELIMINARY COST ESTIMATION

K3.1 Development of dam Reservoirs

K3.1.1 General

The following five dams are planned as adaptation measures against drought. The basic specifications of the five dams are given in Table K3.1.1.

Table K3.1.1 Specification of New Dams

Basin	No.	Name	Status	Dam					Reservoir Capacity (Design) (Million m^3)		
				Type	Height (m)	Crest Width (m)	Crest Length (m)	Embankment Volume (thousand m3)	Gross	Flood Control	Effective Storage
Komering	1	Tiga dihaji Dam	DD 2018 (Bid already)	Rockfill	122.5	12	950	9,600	105	-	65
	3	Saka Dam	FS April 2013	Rockfill	75	12	730	7,120	-	-	20
Lematang	8	Padang Bindu Dam	Pre FS April 2015	Rockfill	109	15	460	11,600	-	-	53
	11	Tanjung Agung	No study	Rockfill	130	15	785	21,900	-	-	43
	15	Panjung	No study	Rockfill	170	20	940	46,100	-	-	106

Source: JICA Project Team 2

K3.1.2 Cost Estimation

The construction costs of the two dams in the Komering Sub-basin, namely Tiga Dihaji and Saka Dams were estimated based on those estimated under the recent the recently conducted design studies. As for the three dams in the Lematang Sub-basin, their construction costs were estimated based on a unit construction cost curve created by using available construction cost data for dams in East Java, West Java and Central Java as well as in South Sumatra. The total project cost was also estimated based on the estimated construction costs under following conditions:

- Price level: March 2019
- Administration cost: 10% of Construction Cost
- Engineering service: 15% of Construction Cost
- Physical contingency: 6% of Construction Cost
- Price escalation: No consideration in the Project
- Compensation cost (Land acquisition and resettlement): 25% of Construction Cost
- VAT: 10%

The estimated project costs of the five dams are summarized in Table K3.1.2. The construction costs of the Tiga Dihaji and Saka Dams are presented in Table K3.1.3. The construction costs of the Padang Bindu, Tanjung Agung and Panjung Dams are given in Table K.3.1.4 and the unit construction cost curve created based on the available cost data in Table K3.1.5 is presented in Figure K3.1.1. Details of the construction costs that were collected form BBWS-S8 are presented in Appendix-3.

Table K3.1.2 Construction Project Cost of New Dam

No.	Name	Dam				Construction cost (10^9 Rap.)									Note
		Type	Height (m)	Crest Length (m)	Embankment Volume (thousand m3)	Direct Cost	Compensation cost	Administration cost	Engineering service	Price escalation	Physical contingency	Total	VAT	Project cost	
						a	b=a*0.25	c=(a+b)*0.1	d=a*0.15	e	f=(a+b+c+d)*0.06	g=(a~f)	h=g*0.1	i=g+h	
Komering	Tiga dihaji Dam	Rockfill	122.5	950	9,600	3,527	882	441	529		323	5,701	570	6,271	Including HP
	Saka Dam	Rockfill	75	730	7,120	1,713	428	214	257		157	2,768	277	3,045	Including HP
Lematang	Padang Bindu Dam	Rockfill	109	460	11,600	3,944	986	493	592		361	6,375	638	7,013	Excluding HP
	Tanjung Agung	Rockfill	130	785	21,900	7,446	1,862	931	1,117		681	12,036	1,204	13,240	Excluding HP
	Panjung	Rockfill	170	940	46,100	15,674	3,919	1,959	2,351		1,434	25,337	2,534	27,871	Excluding HP
	Total					16,629						26,881		29,570	

Source: JICA Project Team 2

Table K3.1.3 Direct Construction Cost of Two Dams in Komering Sub-Basin

Area	Name	Type	Dam body Volume (thousand m3)	Dam construction cost (10^9 Rp.)	Escalation Cost						
					year index *1)	Design time	Current 201903	Dam construction cost (10^9 Rp.)	Rate by region	Region	Dam construction cost (10^9 Rp.)
Komering	Tiga dihaji Dam	Rockfill	9,600	3,404	476.29	2018	493.50	3,527	100.00	South Sumatera	3,527
	Saka Dam	Rockfill	7,120	1,356	390.72	2013/4	493.50	1,713	100.00	South Sumatera	1,713

*1) Index of price rise;2000year = 100

Source: JICA Project Team 2

Table K3.1.4 Direct Construction Cost of Three Dams in Lematang River Basin

Area	No.	Name	Dam					Construction Cost	
			Type	Height (m)	Crest Width (m)	Crest Length (m)	Effective Storage of Reservoir Capacity (Million m3)	Embankment Volume (thousand m3)	Unit Cost (thoisand Rp./m3)	Construction Cost (10^9Rp.) *1)
Lematang	8	Padang Bindu Dam	Rockfill	109	15	460	53	11,600	340	3,944
	11	Tanjung Agung	Rockfill	130	15	785	43	21,900	340	7,446
	15	Panjung	Rockfill	170	20	940	106	46,100	340	15,674

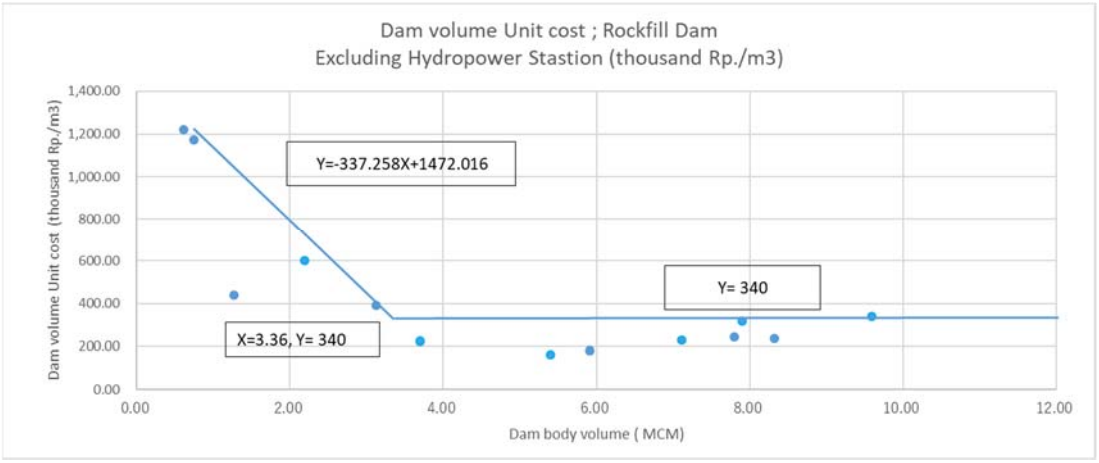
Source: JICA Project Team 2

Table K3.1.5 Unit Cost of Direct Construction (Rockfill Dam)

No.	Dam Name	Province Name	Design Year	Vol. (10^6 m^3)	Unit Cost (Rp.10^3/m^3)	Coefficent*1)	Unit Cost at 2018 (Rp. 10^3/m^3)
1	Tiga Dihaji (new)	South Sumatera	2018	9.60	324.79	103.61	336.53
2	Tiga Dihaji	South Sumatera	2013/4	7.90	251.14	126.31	317.20
3	Komering 1	South Sumatera	1982/3	2.20	18.36	3,273.00	601.04
4	Saka	South Sumatera	2013/4	7.12	179.49	126.31	226.71
5	Tanjung Pura	South Sumatera	2015/4	3.70	197.57	113.46	224.16
6	Buluh	South Sumatera	2015/4	5.40	140.00	113.46	158.85
7	Babadan	East Java	2000	8.32	50.89	463.95	236.10
8	Genteng I	East Java	2000	3.12	84.42	463.95	391.66
9	Kuncir	East Java	2008	5.91	123.83	146.36	181.23
10	Kampak	East Java	2016	1.27	414.53	105.92	439.09
11	Tugu	East Java	2013/12	7.80	210.16	115.27	242.24
12	Bagong	East Java	2014	3.70	198.33	111.53	221.19
13	Bajulmati	West Java	2006/8	0.75	570.17	205.75	1,173.13
14	Jatibarang	Central Java	2009/8	0.61	857.62	142.34	1,220.75

*1): Coefficient is estimated from escalation from estimated year to 2018 and regional economic condition (refer to Appendices 4 and 5).

Source:BBWS-S8



Source: JICA Project Team 2

Figure K3.1.1 Curve of Dam Volume and Unit Cost (Rockfill Dam)

K3.2 Development of DMI Water Supply Facilities

K3.2.1 General

For the four sub-basins, namely Komering, Lematang, Lakitan and Kelingi Sub-basins where water shortage is projected in the future, costs for the development of Domestic, Municipal and Industrial (DMI) water supply facilities are preliminarily estimated as follows:

K3.2.2 Conditions of Facility Plan

Following facilities are considered for the cost estimation:

- Facilities required for meeting demands covered by PDAM water supply
- Water supply pipes according to increase of PDAM coverage

- Replacement of existing pipes for NRW reduction.

K3.2.3 Unit Costs applied for Preliminary Construction Cost Estimation

Following unit costs were assumed for the cost estimation:

- USD400/m^3 for water production facility, as average value of water treatment plant and more simple treatment facility without major civil works
- USD200/m and USD100/m for installation of transmission pipe and distribution pipe, respectively, used for pipe replacement cost for NRW reduction as well
- USD0.15/m^3 for water production cost, including electricity cost and chemicals.

K3.2.4 Cost Summary

The cost summaries are given in Tables K3.2.1 and K3.2.2, which includes costs of every five years necessary for the increasing water demands up to 2050.

Table K3.2.1 Construction Cost Summary for Water Supply Facilities (1/2)

(Unit : US$ x 1,000)

Year	2015	2020	2025	2030	2035	2040	2045	2050
Komering Sub-system 5								
Demand (PDAM + Ind.) (m^3/day)	15,411	50,393	84,794	119,203	153,278	186,710	219,616	252,221
Treatment Plant		12,800	28,000	0	26,800	0	26,000	0
Pipes		5,628	5,628	5,226	5,628	5,628	5,226	5,628
NRW reduction cost		2,814	1,407	804	804	603	603	402
Total Construction Cost		21,242	35,035	6,030	33,232	6,231	31,829	6,030
Lematang Sub-system 5								
Demand (PDAM + Ind.) (m^3/day)	26,366	49,563	75,515	103,584	133,261	163,786	194,296	224,805
Treatment Plant		9,200	22,000	0	24,000	0	24,000	0
Transmission pipe		9,590	9,590	9,590	9,590	9,590	9,590	9,590
NRW reduction cost		0	400	799	400	799	400	400
Total Construction Cost		18,790	31,990	10,390	33,990	10,390	33,990	9,990

Source: JICA Project Team 2

Table K3.2.2 Construction Cost Summary for Water Supply Facilities (2/2)

(Unit : US$ x 1,000)

Year	2015	2020	2025	2030	2035	2040	2045	2050
Lakitan Sub-system 2								
Demand (PDAM + Ind.) (m^3/day)	14,577	21,202	27,589	33,677	39,451	44,712	49,240	53,215
Treatment Plant		2,800	4,800	0	2,800	1,600	2,000	1,600
Transmission pipe		2,059	2,059	2,246	2,059	2,059	2,246	2,059
NRW reduction cost		749	562	374	374	374	281	374
Total Construction Cost		5,608	7,421	2,621	5,234	4,034	4,527	4,034
Kelingi Sub-system 2								
Demand (PDAM + Ind.) (m^3/day)	24,843	35,487	45,592	55,608	64,998	74,195	82,394	89,627
Treatment Plant		5,200	8,000	0	8,000	0	2,800	2,800
Transmission pipe		3,340	3,036	3,340	3,036	3,340	3,036	3,340
NRW reduction cost		759	607	607	455	455	455	455
Total Construction Cost		9,299	11,643	3,947	11,491	3,795	6,291	6,595

Source: JICA Project Team 2

K3.2.5 Annual Cost Schedule

Based on Tables K3.2.1 and K3.2.2, annual cost schedules by sub-basins are prepared as shown in Tables K3.2.3 and K3.2.4.

Table K3.2.3 Annual Cost Schedule for DMI Water Supply Facilities (1/2)

Year	Komering Sub-system 5 (10^9 Rap.)					Lematang Sub-system 5 (10^9 Rap.)				
	WTP construction cost	Pipe Installation cost	NRW reduction cost	Total	O&M cost in WTP	WTP construction cost	Pipe Installation cost	NRW reduction cost	Total	O&M cost in WTP
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	182.2	80.1	5.7	268.0	0.0	130.9	136.5	5.7	273.1	0.0
2021	0.0	0.0	1.1	1.1	35.3	0.0	0.0	0.0	0.0	34.8
2022	0.0	0.0	1.1	1.1	35.3	0.0	0.0	0.0	0.0	34.8
2023	0.0	0.0	1.1	1.1	35.3	0.0	0.0	0.0	0.0	34.8
2024	199.2	40.0	1.1	240.4	35.3	156.5	68.2	0.0	224.8	34.8
2025	199.2	40.0	1.1	240.4	35.3	156.5	68.2	0.0	224.8	34.8
2026	0.0	0.0	1.7	1.7	59.5	0.0	0.0	1.1	1.1	53.0
2027	0.0	0.0	1.7	1.7	59.5	0.0	0.0	1.1	1.1	53.0
2028	0.0	0.0	1.7	1.7	59.5	0.0	0.0	1.1	1.1	53.0
2029	0.0	37.2	1.7	38.9	59.5	0.0	68.2	1.1	69.4	53.0
2030	0.0	37.2	1.7	38.9	83.6	0.0	68.2	1.1	69.4	72.6
2031	0.0	0.0	1.1	1.1	83.6	0.0	0.0	1.1	1.1	72.6
2032	0.0	0.0	1.1	1.1	83.6	0.0	0.0	1.1	1.1	72.6
2033	0.0	0.0	1.1	1.1	83.6	0.0	0.0	1.1	1.1	72.6
2034	190.7	40.0	1.1	231.9	83.6	170.8	68.2	1.1	240.1	72.6
2035	190.7	40.0	1.1	231.9	83.6	170.8	68.2	1.1	240.1	72.6
2036	0.0	0.0	1.1	1.1	107.5	0.0	0.0	1.1	1.1	93.4
2037	0.0	0.0	1.1	1.1	107.5	0.0	0.0	1.1	1.1	93.4
2038	0.0	0.0	1.1	1.1	107.5	0.0	0.0	1.1	1.1	93.4
2039	0.0	40.0	1.1	41.2	107.5	0.0	68.2	1.1	69.4	93.4
2040	0.0	40.0	1.1	41.2	130.9	0.0	68.2	1.1	69.4	114.9
2041	0.0	0.0	1.1	1.1	130.9	0.0	0.0	1.1	1.1	114.9
2042	0.0	0.0	1.1	1.1	130.9	0.0	0.0	1.1	1.1	114.9
2043	0.0	0.0	1.1	1.1	130.9	0.0	0.0	1.1	1.1	114.9
2044	185.0	37.2	1.1	223.3	130.9	170.8	68.2	1.1	240.1	114.9
2045	185.0	37.2	1.1	223.3	130.9	170.8	68.2	1.1	240.1	114.9
2046	0.0	0.0	1.1	1.1	154.0	0.0	0.0	1.1	1.1	136.2
2047	0.0	0.0	1.1	1.1	154.0	0.0	0.0	1.1	1.1	136.2
2048	0.0	0.0	1.1	1.1	154.0	0.0	0.0	1.1	1.1	136.2
2049	0.0	40.0	1.1	41.2	154.0	0.0	68.2	1.1	69.4	136.2
2050	0.0	40.0	1.1	41.2	176.9	0.0	68.2	1.1	69.4	157.6
Total	1332.0	549.2	42.9	1924.1	2924.4	1127.1	955.4	34.1	2116.6	2586.9

1USD=14,231 Rp. (as of 2019/3)
Source: JICA Project Team 2

Table K3.2.4 Annual Cost Schedule for Water Supply Facilities (2/2)

Year	Lakitan Sub-system 2 (10^9 Rap.)					Kelingi Sub-system 2 (10^9 Rap.)				
	WTP construction cost	Pipe Installation cost	NRW reduction cost	Total	O&M cost in WTP	WTP construction cost	Pipe Installation cost	NRW reduction cost	Total	O&M cost in WTP
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	39.8	29.3	4.0	73.1	0.0	74.0	47.5	6.5	128.0	0.0
2021	0.0	0.0	0.8	0.8	14.9	0.0	0.0	0.9	0.9	24.9
2022	0.0	0.0	0.8	0.8	14.9	0.0	0.0	0.9	0.9	24.9
2023	0.0	0.0	0.8	0.8	14.9	0.0	0.0	0.9	0.9	24.9
2024	34.2	14.7	0.8	49.6	14.9	56.9	21.6	0.9	79.4	24.9
2025	34.2	14.7	0.8	49.6	14.9	56.9	21.6	0.9	79.4	24.9
2026	0.0	0.0	0.5	0.5	19.3	0.0	0.0	1.3	1.3	32.0
2027	0.0	0.0	0.5	0.5	19.3	0.0	0.0	1.3	1.3	32.0
2028	0.0	0.0	0.5	0.5	19.3	0.0	0.0	1.3	1.3	32.0
2029	0.0	16.0	0.5	16.5	19.3	0.0	23.8	1.3	25.1	32.0
2030	0.0	16.0	0.5	16.5	23.6	0.0	23.8	1.3	25.1	39.0
2031	0.0	0.0	0.8	0.8	23.6	0.0	0.0	1.3	1.3	39.0
2032	0.0	0.0	0.8	0.8	23.6	0.0	0.0	1.3	1.3	39.0
2033	0.0	0.0	0.8	0.8	23.6	0.0	0.0	1.3	1.3	39.0
2034	19.9	14.7	0.8	35.4	23.6	56.9	21.6	1.3	79.8	39.0
2035	19.9	14.7	0.8	35.4	23.6	56.9	21.6	1.3	79.8	39.0
2036	0.0	0.0	0.8	0.8	27.7	0.0	0.0	1.3	1.3	45.6
2037	0.0	0.0	0.8	0.8	27.7	0.0	0.0	1.3	1.3	45.6
2038	0.0	0.0	0.8	0.8	27.7	0.0	0.0	1.3	1.3	45.6
2039	11.4	14.7	0.8	26.8	27.7	0.0	23.8	1.3	25.1	45.6
2040	11.4	14.7	0.8	26.8	27.7	0.0	23.8	1.3	25.1	52.0
2041	0.0	0.0	0.8	0.8	31.4	0.0	0.0	0.9	0.9	52.0
2042	0.0	0.0	0.8	0.8	31.4	0.0	0.0	0.9	0.9	52.0
2043	0.0	0.0	0.8	0.8	31.4	0.0	0.0	0.9	0.9	52.0
2044	14.2	16.0	0.8	31.0	31.4	19.9	21.6	0.9	42.4	52.0
2045	14.2	16.0	0.8	31.0	31.4	19.9	21.6	0.9	42.4	52.0
2046	0.0	0.0	0.8	0.8	34.5	0.0	0.0	1.3	1.3	57.8
2047	0.0	0.0	0.8	0.8	34.5	0.0	0.0	1.3	1.3	57.8
2048	0.0	0.0	0.8	0.8	34.5	0.0	0.0	1.3	1.3	57.8
2049	11.4	14.7	0.8	26.8	34.5	19.9	23.8	1.3	45.0	57.8
2050	11.4	14.7	0.8	26.8	34.5	19.9	23.8	1.3	45.0	57.8
Total	222.0	210.5	26.6	459.1	761.1	381.4	319.7	41.0	742.2	1269.6

1USD=14,231 Rp. (as of 2019/3)
Source: JICA Project Team 2

K3.3 Development of Irrigation Facilities

K3.3.1 General

For the four sub-basins, namely Komering, Lematang, Lakitan and Kelingi Sub-basins where water shortage is projected in the future, costs for the development of irrigation facilities are preliminarily estimated as follows:

K3.3.2 Unit Cost

The development costs include the construction/improvement costs of the main, secondary and/or tertiary canals and the drain and filed work management cost. The target canals of the canal construction/improvement works including construction of other related facilities such as regulators are different, depending upon the type of the irrigation area as shown in Table

K3.3.1.

The unit cost of the canal construction/improvement cost is assumed by referring to those estimated in 2016 under the Komering Irrigation Project in South Sumatra Province, as presented in Table K3.3.2.

Table K3.3.1 Target Facility of Irrigation Area

Irrigation area	Main canal	Secondary canal	Third canal
New irrigation area	✓	✓	✓
Irrigation area of integration into the country	✓	-	✓
Existing irrigation area	-	-	✓

Source: JICA Project Team 2

Table K3.3.2 Unit Construction Cost of Irrigation Facilities

Item	Region	Design Time	Canal length (m/ha)	Unit	Unit Cost	Coefficient*1)	Unit Cost at 2018	Adopted Unit Cost
Main canal	South Sumatera	2016	0.8	million Rp./km	17,000	1.127	19154.1	19,200
Secondary canal	South Sumatera	2016	9.6	million Rp./km	6,800	1.127	7661.6	7,700
Third canal	South Sumatera	2016	-	million Rp./ha	32	1.127	36.1	37
Drain Field work management cost	South Sumatera	2016	-	million Rp./ha	10	1.127	11.3	12

*1): Coefficient is estimated from escalation from estimated year to 2018 and regional economic condition (refer to Appendices 4 and 5).

Source: JICA Project Team 2

K3.3.3 Development Cost by Sub-basin

The development cost of the irrigation facilities are estimated by sub-basin as presented in TableK3.3.3, based on the above unit costs.

Table K3.3.3 Development Cost of Irrigation Facilities

Sub-River System	Sub-basin	Catchment Area (km^2)	Irrigation Area (ha)										Irrigation facilties cost (10^9Rp.)						
			Central (BBWS-S8)			Province			Regency/City			Sub-total	Main canal	Secondary canal	Third canal	Sub-total	Drain , Field work management cost	Total	Total (Construction costs)
		Sub-basin	Scheme	Area	note	Regency	%	Area	Regency/City	%	Area								
Komering	KOi (RRF)	502				OKU Selatan	13	624	OKU Selatan	13	673	1,297	-	-	48	48	16	64	6,909
	KOii	1,141				OKU Selatan	23	1,104	OKU Selatan	23	1,191	2,295	-	-	85	85	28	112	
	KOiii	1,226				OKU Selatan	33	1,584	OKU Selatan	33	1,709	3,293	-	-	122	122	40	161	
	KO1	1,420	DI. Komering/ Selatan/Way Komering	72,658 (13,491)	existing +new new(add)	OKU Selatan	31	1,488	OKU Selatan	31	1,605	86,086	-	-	2,803	2,803	909	3,712	
													207	997	-	1,204	-	1,204	
			D.I. Komeing Tulang Bawang	10,000	new	OKU Timur	6	295	OKU Timur	6	39		154	739	382	1,275	124	1,399	
			Sub-total	82,658		Sub-total		1,784	Sub-total		1,644		361	1,736	3,185	5,282	1,033	6,315	
	KO2	4,836				OKU Timur	94	4,625	OKU Timur	94	611	5,236	-	-	194	194	63	257	
	Ko_add	600						0			0	0	-	-	0	0	0	0	
	Total	9,725		82,658				9,721			5,829	98,208	361	1,736	3,634	5,731	1,178	6,909	
Lematang	LEi	1,321	DI. Muara Riben	3,050	existing	Pagar Alam	100	1,500	Pagar Alam	100	1,504	25,398	-	-	224	224	73	297	3,703
			D.I. Dongku Kiri / Kanar	10,000	new	Lahat	17	1,265	Lahat	17	1,079		154	739	457	1,350	148	1,498	
			D.I. Lematang	2,000	Integration								31	-	74	105	24	129	
			D.I. Merapi	5,000	Integration								77	-	185	262	60	322	
			Sub-total	20,050		Sub-total		2,765	Sub-total		2,583		261	739	940	1,940	305	2,245	
	LEii	1,220				Lahat	40	2,977	Lahat	40	2,539	5,516	-	-	204	204	66	270	
	LEiii	1,265				Muara Enim	30	2,666	Muara Enim	30	7,298	9,964	-	-	369	369	120	488	
	LE2	3,803				Muara Enim	43	3,821	Muara Enim	43	10,461	14,281	-	-	528	528	171	700	
						Prabumulih Cit	39	0	Prabumulih City	39	0		-	-	0	0	0	0	
						Panukal Abab Lematang Ilir	27	0	Panukal Abab Lematang Ilir	27	0		-	-	0	0	0	0	
						Sub-total		3,821	Sub-total		10,461		-	-	528	528	171	700	
	Total	7,608		20,050				12,229			22,881	55,160	261	739	2,041	3,041	662	3,703	
Lakitan	LAi	629	DI. Air Lakitan	6,920	existing	Musi Rawas	9	541	Musi Rawas	9	591	8,052	-	-	298	298	97	395	986
	LA	2,155	D.I. Kabahang	3,000	new	Musi Rawas	29	1,744	Musi Rawas	29	1,903	7,335	46	222	246	514	80	594	
						Lubuk Linggau	45	0	Lubuk Linggau	45	688		-	-	25	25	8	34	
						Sub-total		1,744	Sub-total		2,591		46	222	271	539	52	591	
	Total	2,784		9,920				2,285			3,182	15,387	46	222	569	837	149	986	
Kelingi	KEi	448	D.I. Kelingi Tugu Mulyo	10,163	existing	Lubuk Linggau	20	0	Lubuk Linggau	20	306	10,469	-	-	387	387	126	513	619
						Rajang Lebong	23	0	Rajang Lebong	23	0		-	-	0	0	0	0	
						Sub-total		0	Sub-total		306		-	-	387	387	126	513	
	KE	1,483				Lubuk Linggau	35	0	Lubuk Linggau	35	535	2,165	-	-	20	20	6	26	
						Empat Lawang	7	105	Empat Lawang	7	393		-	-	18	18	6	24	
						Musi Rawas	9	541	Musi Rawas	9	591		-	-	42	42	14	55	
						Rajang Lebong	38	0	Rajang Lebong	38	0		-	-	0	0	0	0	
						Sub-total		646	Sub-total		1,519		-	-	80	80	26	106	
	Total	1,931		10,163				646			1,825	12,634	-	-	467	467	152	619	
																	Total		12,217

Source: JICA Project Team 2

CHAPTER K4 DISBURSEMENT SCHEDULE OF PROJECT COST

K4.1 Estimation of Total Project Cost

Based on the above discussions, the total project cost of water resources development and water supply of the four sub-basins was made under following conditions:

- Price level: March 2019
- Administration cost: 10% of Construction Cost
- Engineering service: 15% of Construction Cost
- Physical contingency: 6% of Construction Cost
- Price escalation: No consideration in the Project
- Compensation cost (Land acquisition and resettlement): 25% of Construction Cost
- VAT: 10%

The estimated project cost is presented in Table K4.1.1.

K4.2 The Disbursement Schedule of Project Cost

Based on the Project Implementation Schedule given in Table 10.5.4 of the Main Report, A project cost disbursement schedule by sub-basin was prepared as shown in Tables K4.2.1 to K4.2.12. 0.5% of the construction cost is included as annual O&M cost, and 5% of the construction cost of the irrigation facilities is further added every 10 years as repair cost in the tables.

Table K4.1.1 Results of Project Cost

Sub-river basin	Category	Measures	Construction cost (10^9 Rap.)									
			Direct Cost	Compensation cost	Administration cost	Engineering service	Price escalation	Physical contingency	Total	VAT	Project cost	Total adjustment of project cost
			a	b=a*0.25	c=(a+b)*0.1	d=a*0.15	e	f=(a+b+c+d)*0.06	g=(a～f)	h=g*0.1	i=g+h	
				0.25	0.1	0.15		0.06		0.1		
Komering	Dam Reservoirs	Construction of Tiga Dihaji Dam	3,527	882	441	529		323	5,701	570	6,271	6,271
		Modification of RRF Operation	0	0	0	0		0	0	0	0	0
		Construction of Saka Dam	1,713	428	214	257		157	2,768	277	3,045	3,045
		Sub-total	5,239						8,469		9,316	9,316
	Development of DMI Water Supply	Construction of WTP	1,332	333	167	200		122	2,153	215	2,369	2,369
		Development of Pipe Network	549	137	69	82		50	888	89	977	977
		Reduction of NRW	43	11	5	6		4	69	7	76	76
		Sub-total	1,924						3,110		3,421	3,422
	Development of Irrigation Water Supply	Development of Main Canals	361	90	45	54		33	583	58	642	642
		Development of Secondary Canals	1,736	434	217	260		159	2,807	281	3,088	3,088
		Development of Tertiary Canals	3,634	908	454	545		332	5,874	587	6,461	6,461
		Management of Drains and filed works	1,178	295	147	177		108	1,905	191	2,096	2,096
		Sub-total	6,909						11,169		12,286	12,287
	Sub-total		14,073						22,749		25,024	25,025
Lematang	Development of Dam Reservoirs	Construction of Padang Bindu Dam	4,060	1,015	508	609		371	6,563	656	7,219	7,219
		Construction of Tanjung Agung Dam	7,665	1,916	958	1,150		701	12,390	1,239	13,630	13,630
		Construction of Panjung Dam	16,135	4,034	2,017	2,420		1,476	26,082	2,608	28,690	28,690
		Sub-total	27,860						45,036		49,539	49,539
	Development of DMI Water Supply	Construction of WTP	1,127	282	141	169		103	1,822	182	2,004	2,004
		Development of Pipe Network	955	239	119	143		87	1,544	154	1,699	1,699
		Reduction of NRW	34	9	4	5		3	55	6	61	61
		Sub-total	2,117						3,421		3,764	3,764
	Development of Irrigation Water Supply	Development of Main Canals	261	65	33	39		24	422	42	464	464
		Development of Secondary Canals	739	185	92	111		68	1,195	119	1,314	1,314
		Development of Tertiary Canals	2,041	510	255	306		187	3,299	330	3,629	3,629
		Management of Drains and filed works	662	165	83	99		61	1,070	107	1,177	1,177
		Sub-total	3,703						5,986		6,585	6,584
	Sub-total		33,680						54,443		59,888	59,887
Kelingi	Development of DMI Water Supply	Construction of WTP	381	95	48	57		35	617	62	678	678
		Development of Pipe Network	320	80	40	48		29	517	52	569	569
		Reduction of NRW	41	10	5	6		4	66	7	73	73
		Sub-total	742						1,200		1,320	1,320
	Development of Irrigation Water Supply	Development of Main Canals	-	-	-	-	-	-	-	-	-	-
		Development of Secondary Canals	-	-	-	-	-	-	-	-	-	-
		Development of Tertiary Canals	467	117	58	70		43	756	76	831	831
		Management of Drains and filed works	152	38	19	23		14	245	25	270	270
		Sub-total	619						1,001		1,101	1,101
	Sub-total		1,361						2,200		2,420	2,421
Lakitan	Development of DMI Water Supply	Construction of WTP	222	56	28	33		20	359	36	395	395
		Development of Pipe Network	210	53	26	32		19	340	34	374	374
		Reduction of NRW	27	7	3	4		2	43	4	47	47
		Sub-total	459						742		816	816
	Development of Irrigation Water Supply	Development of Main Canals	46	12	6	7		4	74	7	82	82
		Development of Secondary Canals	222	55	28	33		20	358	36	394	394
		Development of Tertiary Canals	569	142	71	85		52	920	92	1,012	1,012
		Management of Drains and filed works	149	37	19	22		14	240	24	264	264
		Sub-total	718						1,594		1,753	1,752
	Sub-total		1,177						2,336		2,569	2,568
Total	Development of Dam Reservoirs		33,099						53,505		58,856	58,855
	Development of DMI Water Supply		5,242						8,474		9,321	9,322
	Development of Irrigation Water Supply		11,950						19,750		21,724	21,724
	Grand Total		50,291						81,728		89,901	89,901

Source: JICA Project Team 2

Table K4.2.1 Disbursement Schedule of Project Cost (Komering Area;1/3)

No.	Description	Percentage	year	Total Amount	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1	**Direct Cost**													
1.1	Construction of Tiga Dihaji Dam		3	3,527	1,176	1,176	1,176							
1.2	Modification of RRF Operation		2	0				0	0					
1.3	Construction of Saka Dam		5	1,713						343	343	343	343	343
1.4	Development of DMI Water Facility		31	1,924	268	1	1	1	240	240	2	2	2	39
1.5	Development of Irrigation Facility			6,909										
	Area of Tiga Dihaji Dam		3	1,633	544	544	544							
	Area of RRF		2	4,774				2,387	2,387					
	Area of Saka Dam		5	503						101	101	101	101	101
Sub-Total 1				14,073	1,988	1,721	1,721	2,388	2,627	683	445	445	445	482
2	**Compensation Cost; =1 *25%**	25%												
2.1	Construction of Tiga Dihaji Dam		3	882	294	294	294	0	0	0	0	0	0	0
2.2	Modification of RRF Operation		2	0	0	0	0	0	0	0	0	0	0	0
2.3	Construction of Saka Dam		5	428	0	0	0	0	0	86	86	86	86	86
2.4	Development of DMI Water Facility		31	481	67	0	0	0	60	60	0	0	0	10
2.5	Development of Irrigation Facility		21	1,727	136	136	136	597	597	25	25	25	25	25
Sub-total 2				3,518	497	430	430	597	657	171	111	111	111	120
3	Administration Cost; =(1+2) *10%	10%												
				1,759	248	215	215	299	328	85	56	56	56	60
4	Engineering Services; =1 *15%	15%												
				2,111	298	258	258	358	394	103	67	67	67	72
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		1,288	182	157	157	219	240	63	41	41	41	44
Sub-total 5				1,288	182	157	157	219	240	63	41	41	41	44
Subtotal (1-5)					3,214	2,782	2,782	3,860	4,247	1,105	719	719	719	779
VAT	1-5の10%	10%												
					321	278	278	386	425	110	72	72	72	78
Total					3,535	3,060	3,060	4,246	4,672	1,215	791	791	791	857
6	Operation & Maintenance *1)													
6.1	Construction of Tiga Dihaji Dam	0.5%		18	6	12	18	18	18	18	18	18	18	18
6.2	Modification of RRF Operation	0.5%		0				0	0	0	0	0	0	0
6.3	Construction of Saka Dam	0.5%		9						2	3	5	7	9
6.4	Development of DMI Water Facility	-		177	0	35	35	35	35	35	59	59	59	59
6.5	Development of Irrigation Facility	0.5%		35	3	5	8	20	32	33	33	34	34	35
6.6	Development of Irrigation Facility	5.0%		345										
Sub-total 6					9	53	61	73	85	87	114	116	118	120
Subtotal (1-6)					3,222	2,835	2,843	3,933	4,332	1,192	832	835	837	899
VAT	1-6の10%	10%												
					322	283	284	393	433	119	83	83	84	90
Total					3,544	3,118	3,128	4,327	4,765	1,311	916	918	921	989

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.2 Disbursement Schedule of Project Cost (Komering area;2/3)

No.	Description	Percentage	year	Total Amount	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
1	**Direct Cost**													
1.1	Construction of Tiga Dihaji Dam		3	3,527										
1.2	Modification of RRF Operation		2	0										
1.3	Construction of Saka Dam		5	1,713										
1.4	Development of DMI Water Facility		31	1,924	39	1	1	1	232	232	1	1	1	41
1.5	Development of Irrigation Facility			6,909										
	Area of Tiga Dihaji Dam		3	1,633										
	Area of RRF		2	4,774										
	Area of Saka Dam		5	503										
Sub-Total 1				14,073	39	1	1	1	232	232	1	1	1	41
2	**Compensation Cost; =1 *25%**	25%												
2.1	Construction of Tiga Dihaji Dam		3	882	0	0	0	0	0	0	0	0	0	0
2.2	Modification of RRF Operation		2	0	0	0	0	0	0	0	0	0	0	0
2.3	Construction of Saka Dam		5	428	0	0	0	0	0	0	0	0	0	0
2.4	Development of DMI Water Facility		31	481	10	0	0	0	58	58	0	0	0	10
2.5	Development of Irrigation Facility		21	1,727	0	0	0	0	0	0	0	0	0	0
Sub-total 2				3,518	10	0	0	0	58	58	0	0	0	10
3	Administration Cost; =(1+2) *10%	10%												
				1,759	5	0	0	0	29	29	0	0	0	5
4	Engineering Services; =1 *15%	15%												
				2,111	6	0	0	0	35	35	0	0	0	6
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		1,288	4	0	0	0	21	21	0	0	0	4
Sub-total 5				1,288	4	0	0	0	21	21	0	0	0	4
Subtotal (1-5)					63	2	2	2	375	375	2	2	2	67
VAT	1-5の10%	10%												
					6	0	0	0	37	37	0	0	0	7
Total					69	2	2	2	412	412	2	2	2	73
6	Operation & Maintenance *1)													
6.1	Construction of Tiga Dihaji Dam	0.5%		18	18	18	18	18	18	18	18	18	18	18
6.2	Modification of RRF Operation	0.5%		0	0	0	0	0	0	0	0	0	0	0
6.3	Construction of Saka Dam	0.5%		9	9	9	9	9	9	9	9	9	9	9
6.4	Development of DMI Water Facility	-		177	84	84	84	84	84	84	107	107	107	107
6.5	Development of Irrigation Facility	0.5%		35	35	35	35	35	35	35	35	35	35	35
6.6	Development of Irrigation Facility	5.0%		345			82							25
Sub-total 6					144	144	226	144	144	144	168	168	168	193
Subtotal (1-6)					207	146	228	146	519	519	170	170	170	260
VAT	1-6の10%	10%												
					21	15	23	15	52	52	17	17	17	26
Total					228	161	251	161	571	571	187	187	187	286

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.3 Disbursement Schedule of Project Cost (Komering area;3/3)

No.	Description	Percentage	year	Total Amount	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
1	**Direct Cost**														
1.1	Construction of Tiga Dihaji Dam		3	3,527											
1.2	Modification of RRF Operation		2	0											
1.3	Construction of Saka Dam		5	1,713											
1.4	Development of DMI Water Facility		31	1,924	41	1	1	1	223	223	1	1	1	41	41
1.5	Development of Irrigation Facility			6,909											
	Area of Tiga Dihaji Dam		3	1,633											
	Area of RRF		2	4,774											
	Area of Saka Dam		5	503											
Sub-Total 1				14,073	41	1	1	1	223	223	1	1	1	41	41
2	**Compensation Cost; =1 *25%**	25%													
2.1	Construction of Tiga Dihaji Dam		3	882	0	0	0	0	0	0	0	0	0	0	0
2.2	Modification of RRF Operation		2	0	0	0	0	0	0	0	0	0	0	0	0
2.3	Construction of Saka Dam		5	428	0	0	0	0	0	0	0	0	0	0	0
2.4	Development of DMI Water Facility		31	481	10	0	0	0	56	56	0	0	0	10	10
2.5	Development of Irrigation Facility		21	1,727	0	0	0	0	0	0	0	0	0	0	0
Sub-total 2				3,518	10	0	0	0	56	56	0	0	0	10	10
3	Administration Cost; =(1+2) *10%	10%													
				1,759	5	0	0	0	28	28	0	0	0	5	5
4	Engineering Services; =1 *15%	15%													
				2,111	6	0	0	0	33	33	0	0	0	6	6
5	Contingency														
5.1	Price escalation														
5.2	Physical contingency; =(1+2+3+4) *6%														
		6%		1,288	4	0	0	0	20	20	0	0	0	4	4
Sub-total 5				1,288	4	0	0	0	20	20	0	0	0	4	4
Subtotal (1-5)					67	2	2	2	361	361	2	2	2	67	67
VAT	1-5の10%	10%													
					7	0	0	0	36	36	0	0	0	7	7
Total					73	2	2	2	397	397	2	2	2	73	73
6	Operation & Maintenance *1)														
6.1	Construction of Tiga Dihaji Dam	0.5%		18	18	18	18	18	18	18	18	18	18	18	18
6.2	Modification of RRF Operation	0.5%		0	0	0	0	0	0	0	0	0	0	0	0
6.3	Construction of Saka Dam	0.5%		9	9	9	9	9	9	9	9	9	9	9	9
6.4	Development of DMI Water Facility	-		177	131	131	131	131	131	131	154	154	154	154	177
6.5	Development of Irrigation Facility	0.5%		35	35	35	35	35	35	35	35	35	35	35	35
6.6	Development of Irrigation Facility	5.0%		345			82							25	
Sub-total 6					192	192	273	192	192	192	215	215	215	240	238
Subtotal (1-6)					258	194	275	194	553	553	217	217	217	306	304
VAT	1-6の10%	10%													
					26	19	28	19	55	55	22	22	22	31	30
Total					284	213	303	213	608	608	238	238	238	337	335

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.4 Disbursement Schedule of Project Cost (Lematang area ; 1/3)

No.	Description	Percentage	year	Total Amount	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1	**Direct Cost**													
1.1	Construction of Pandang Bindu Dam		5	4,060										
1.2	Construction of Tanjung Agung Dam		7	7,665										
1.3	Construction of Panjung Dam		9	16,135										
1.4	Development of DMI Water Facility		31	2,117	273	0	0	0	225	225	1	1	1	69
1.5	Development of Irrigation Facility			3,703										
	Area of Pandang Bindu Dam		5	962										
	Area of Tanjung Agung Dam		7	817										
	Area of Panjung Dam		9	1,924										
Sub-Total 1				33,680	273	0	0	0	225	225	1	1	1	69
2	**Compensation Cost; =1 *25%**	25%												
2.1	Construction of Pandang Bindu Dam		5	1,015	0	0	0	0	0	0	0	0	0	0
2.2	Construction of Tanjung Agung Dam		7	1,916	0	0	0	0	0	0	0	0	0	0
2.3	Construction of Panjung Dam		9	4,034	0	0	0	0	0	0	0	0	0	0
2.4	Development of DMI Water Facility		31	529	68	0	0	0	56	56	0	0	0	17
2.5	Development of Irrigation Facility		21	926	0	0	0	0	0	0	0	0	0	0
Sub-total 2				8,420	68	0	0	0	56	56	0	0	0	17
3	Administration Cost; =(1+2) *10%	10%												
				4,210	34	0	0	0	28	28	0	0	0	9
4	Engineering Services; =1 *15%	15%												
				5,052	41	0	0	0	34	34	0	0	0	10
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		3,082	25	0	0	0	21	21	0	0	0	6
Sub-total 5				3,082	25	0	0	0	21	21	0	0	0	6
Subtotal (1-5)					441	0	0	0	363	363	2	2	2	112
VAT	1-5の10%	10%												
					44	0	0	0	36	36	0	0	0	11
Total					486	0	0	0	400	400	2	2	2	123
6	Operation & Maintenance *1)													
6.1	Construction of Pandang Bindu Dam	0.5%		20										
6.2	Construction of Tanjung Agung Dam	0.5%		38										
6.3	Construction of Panjung Dam	0.5%		81										
6.4	Development of DMI Water Facility	-		158		35	35	35	35	35	53	53	53	53
6.5	Development of Irrigation Facility	0.5%		19										
6.6	Development of Irrigation Facility	5.0%		185										
Sub-total 6					0	35	35	35	35	35	53	53	53	53
Subtotal (1-6)					441	35	35	35	398	398	55	55	55	165
VAT	1-6の10%	10%												
					44	3	3	3	40	40	5	5	5	17
Total					486	38	38	38	438	438	60	60	60	182

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.5 Disbursement Schedule of Project Cost (Lematang area ; 2/3)

No.	Description	Percentage	year	Total Amount	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
1	**Direct Cost**													
1.1	Construction of Pandang Bindu Dam		5	4,060	812	812	812	812	812					
1.2	Construction of Tanjung Agung Dam		7	7,665						1,095	1,095	1,095	1,095	1,095
1.3	Construction of Panjung Dam		9	16,135										
1.4	Development of DMI Water Facility		31	2,117	69	1	1	1	240	240	1	1	1	69
1.5	Development of Irrigation Facility			3,703										
	Area of Pandang Bindu Dam		5	962	192	192	192	192	192					
	Area of Tanjung Agung Dam		7	817						117	117	117	117	117
	Area of Panjung Dam		9	1,924										
Sub-Total 1				33,680	1,074	1,006	1,006	1,006	1,245	1,452	1,213	1,213	1,213	1,281
2	**Compensation Cost; =1 *25%**	25%												
2.1	Construction of Pandang Bindu Dam		5	1,015	203	203	203	203	203	0	0	0	0	0
2.2	Construction of Tanjung Agung Dam		7	1,916	0	0	0	0	0	274	274	274	274	274
2.3	Construction of Panjung Dam		9	4,034	0	0	0	0	0	0	0	0	0	0
2.4	Development of DMI Water Facility		31	529	17	0	0	0	60	60	0	0	0	17
2.5	Development of Irrigation Facility		21	926	48	48	48	48	48	29	29	29	29	29
Sub-total 2				8,420	268	251	251	251	311	363	303	303	303	320
3	Administration Cost; =(1+2) *10%	10%												
				4,210	134	126	126	126	156	181	152	152	152	160
4	Engineering Services; =1 *15%	15%												
				5,052	161	151	151	151	187	218	182	182	182	192
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		3,082	98	92	92	92	114	133	111	111	111	117
Sub-total 5				3,082	98	92	92	92	114	133	111	111	111	117
Subtotal (1-5)					1,736	1,625	1,625	1,625	2,012	2,347	1,961	1,961	1,961	2,071
VAT	1-5の10%	10%												
					174	163	163	163	201	235	196	196	196	207
Total					1,909	1,788	1,788	1,788	2,213	2,582	2,157	2,157	2,157	2,278
6	Operation & Maintenance *1)													
6.1	Construction of Pandang Bindu Dam	0.5%		20	4	8	12	16	20	20	20	20	20	20
6.2	Construction of Tanjung Agung Dam	0.5%		38						5	11	16	22	27
6.3	Construction of Panjung Dam	0.5%		81										
6.4	Development of DMI Water Facility	-		158	73	73	73	73	73	73	93	93	93	93
6.5	Development of Irrigation Facility	0.5%		19	1	2	3	4	5	5	6	7	7	8
6.6	Development of Irrigation Facility	5.0%		185										
Sub-total 6					78	83	88	93	98	104	131	137	143	149
Subtotal (1-6)					1,813	1,708	1,713	1,718	2,110	2,451	2,091	2,097	2,103	2,220
VAT	1-6の10%	10%												
					181	171	171	172	211	245	209	210	210	222
Total					1,995	1,879	1,885	1,890	2,321	2,696	2,300	2,307	2,314	2,442

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.6 Disbursement Schedule of Project Cost (Lematang area ; 3/3)

No.	Description	Percentage	year	Total Amount	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
1	**Direct Cost**														
1.1	Construction of Pandang Bindu Dam		5	4,060											
1.2	Construction of Tanjung Agung Dam		7	7,665	1,095	1,095									
1.3	Construction of Panjung Dam		9	16,135			1,793	1,793	1,793	1,793	1,793	1,793	1,793	1,793	1,793
1.4	Development of DMI Water Facility		31	2,117	69	1	1	1	240	240	1	1	1	69	69
1.5	Development of Irrigation Facility			3,703											
	Area of Pandang Bindu Dam		5	962											
	Area of Tanjung Agung Dam		7	817	117	117									
	Area of Panjung Dam		9	1,924			214	214	214	214	214	214	214	214	214
Sub-Total 1				33,680	1,281	1,213	2,008	2,008	2,247	2,247	2,008	2,008	2,008	2,076	2,076
2	**Compensation Cost; =1 *25%**	25%													
2.1	Construction of Pandang Bindu Dam		5	1,015	0	0	0	0	0	0	0	0	0	0	0
2.2	Construction of Tanjung Agung Dam		7	1,916	274	274	0	0	0	0	0	0	0	0	0
2.3	Construction of Panjung Dam		9	4,034	0	0	448	448	448	448	448	448	448	448	448
2.4	Development of DMI Water Facility		31	529	17	0	0	0	60	60	0	0	0	17	17
2.5	Development of Irrigation Facility		21	926	29	29	53	53	53	53	53	53	53	53	53
Sub-total 2				8,420	320	303	502	502	562	562	502	502	502	519	519
3	**Administration Cost; =(1+2) *10%**	10%													
				4,210	160	152	251	251	281	281	251	251	251	259	259
4	**Engineering Services; =1 *15%**	15%													
				5,052	192	182	301	301	337	337	301	301	301	311	311
5	**Contingency**														
5.1	Price escalation														
5.2	Physical contingency; =(1+2+3+4) *6%														
		6%		3,082	117	111	184	184	206	206	184	184	184	190	190
Sub-total 5				3,082	117	111	184	184	206	206	184	184	184	190	190
Subtotal (1-5)					2,071	1,961	3,245	3,245	3,632	3,632	3,245	3,245	3,245	3,356	3,356
VAT	1-5の10%	10%													
					207	196	325	325	363	363	325	325	325	336	336
Total					2,278	2,157	3,570	3,570	3,995	3,995	3,570	3,570	3,570	3,691	3,691
6	**Operation & Maintenance *1)**														
6.1	Construction of Pandang Bindu Dam	0.5%		20	20	20	20	20	20	20	20	20	20	20	20
6.2	Construction of Tanjung Agung Dam	0.5%		38	33	38	38	38	38	38	38	38	38	38	38
6.3	Construction of Panjung Dam	0.5%		81			9	18	27	36	45	54	63	72	81
6.4	Development of DMI Water Facility	-		158	115	115	115	115	115	115	136	136	136	136	158
6.5	Development of Irrigation Facility	0.5%		19	8	9	10	11	12	13	14	15	16	17	19
6.6	Development of Irrigation Facility	5.0%		185					48						
Sub-total 6					176	182	192	202	261	223	254	264	274	284	315
Subtotal (1-6)					2,247	2,143	3,438	3,448	3,892	3,854	3,499	3,509	3,519	3,640	3,671
VAT	1-6の10%	10%													
					225	214	344	345	389	385	350	351	352	364	367
Total					2,472	2,357	3,782	3,793	4,282	4,240	3,849	3,860	3,871	4,004	4,038

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.7 Disbursement Schedule of Project Cost (Kelingi area ; 1/3)

No.	Description	Percentage	year	Total Amount	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1	**Direct Cost**													
1.1	Development of DMI Water Facility		31	742	128	1	1	1	79	79	1	1	1	25
1.2	Development of Irrigation Facility		31	619	20	20	20	20	20	20	20	20	20	20
Sub-Total 1				1,361	148	21	21	21	99	99	21	21	21	45
2	**Compensation Cost; =1 *25%**	25%												
2.1	Development of DMI Water Facility		31	186	32	0	0	0	20	20	0	0	0	6
2.2	Development of Irrigation Facility		31	155	5	5	5	5	5	5	5	5	5	5
Sub-total 2				340	37	5	5	5	25	25	5	5	5	11
3	Administration Cost; =(1+2) *10%	10%												
				170	18	3	3	3	12	12	3	3	3	6
4	Engineering Services; =1 *15%	15%												
				204	22	3	3	3	15	15	3	3	3	7
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		125	14	2	2	2	9	9	2	2	2	4
Sub-total 5				125	14	2	2	2	9	9	2	2	2	4
Subtotal (1-5)					239	34	34	34	161	161	34	34	34	73
VAT	1-5の10%	10%												
					24	3	3	3	16	16	3	3	3	7
Total					263	37	37	37	177	177	38	38	38	80
6	Operation & Maintenance *1)													
6.1	Development of DMI Water Facility	-		58	0	25	25	25	25	25	32	32	32	32
6.2	Development of Irrigation Facility	0.5%		3	0	0	0	0	0	1	1	1	1	1
6.3	Development of Irrigation Facility	5.0%		31										
Sub-total 6					0	25	25	25	25	25	33	33	33	33
Subtotal (1-6)					239	59	59	59	186	186	67	67	67	106
VAT	1-6の10%	10%												
					24	6	6	6	19	19	7	7	7	11
Total					263	65	65	65	205	205	74	74	74	116

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.8 Disbursement Schedule of Project Cost (Kelingi area ; 2/3)

No.	Description	Percentage	year	Total Amount	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
1	**Direct Cost**													
1.1	Development of DMI Water Facility		31	742	25	1	1	1	80	80	1	1	1	25
1.2	Development of Irrigation Facility		31	619	20	20	20	20	20	20	20	20	20	20
Sub-Total 1				1,361	45	21	21	21	100	100	21	21	21	45
2	**Compensation Cost; =1 *25%**	25%												
2.1	Development of DMI Water Facility		31	186	6	0	0	0	20	20	0	0	0	6
2.2	Development of Irrigation Facility		31	155	5	5	5	5	5	5	5	5	5	5
Sub-total 2				340	11	5	5	5	25	25	5	5	5	11
3	Administration Cost; =(1+2) *10%	10%												
				170	6	3	3	3	12	12	3	3	3	6
4	Engineering Services; =1 *15%	15%												
				204	7	3	3	3	15	15	3	3	3	7
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		125	4	2	2	2	9	9	2	2	2	4
Sub-total 5				125	4	2	2	2	9	9	2	2	2	4
Subtotal (1-5)					73	34	34	34	161	161	34	34	34	73
VAT	1-5の10%	10%												
					7	3	3	3	16	16	3	3	3	7
Total					80	38	38	38	177	177	38	38	38	80
6	Operation & Maintenance *1)													
6.1	Development of DMI Water Facility	-		58	39	39	39	39	39	39	46	46	46	46
6.2	Development of Irrigation Facility	0.5%		3	1	1	1	1	1	2	2	2	2	2
6.3	Development of Irrigation Facility	5.0%		31	10									
Sub-total 6					50	40	40	40	40	41	47	47	47	48
Subtotal (1-6)					123	75	75	75	202	202	82	82	82	120
VAT	1-6の10%	10%												
					12	7	7	7	20	20	8	8	8	12
Total					135	82	82	82	222	222	90	90	90	132

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.9 Disbursement Schedule of Project Cost (Kelingi area ; 3/3)

No.	Description	Percentage	year	Total Amount	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
1	**Direct Cost**														
1.1	Development of DMI Water Facility		31	742	25	1	1	1	42	42	1	1	1	45	45
1.2	Development of Irrigation Facility		31	619	20	20	20	20	20	20	20	20	20	20	20
Sub-Total 1				1,361	45	21	21	21	62	62	21	21	21	65	65
2	**Compensation Cost; =1 *25%**	25%													
2.1	Development of DMI Water Facility		31	186	6	0	0	0	11	11	0	0	0	11	11
2.2	Development of Irrigation Facility		31	155	5	5	5	5	5	5	5	5	5	5	5
Sub-total 2				340	11	5	5	5	16	16	5	5	5	16	16
3	Administration Cost; =(1+2) *10%	10%													
				170	6	3	3	3	8	8	3	3	3	8	8
4	Engineering Services; =1 *15%	15%													
				204	7	3	3	3	9	9	3	3	3	10	10
5	Contingency														
5.1	Price escalation														
5.2	Physical contingency; =(1+2+3+4) *6%														
		6%		125	4	2	2	2	6	6	2	2	2	6	6
Sub-total 5				125	4	2	2	2	6	6	2	2	2	6	6
Subtotal (1-5)					73	34	34	34	101	101	34	34	34	105	105
VAT	1-5の10%	10%													
					7	3	3	3	10	10	3	3	3	10	10
Total					80	37	37	37	111	111	38	38	38	115	115
6	Operation & Maintenance *1)														
6.1	Development of DMI Water Facility	-		58	52	52	52	52	52	52	58	58	58	58	58
6.2	Development of Irrigation Facility	0.5%		3	2	2	2	2	2	3	3	3	3	3	3
6.3	Development of Irrigation Facility	5.0%		31	20										30
Sub-total 6					74	54	54	54	55	55	60	61	61	61	91
Subtotal (1-6)					147	88	88	88	155	155	95	95	95	166	196
VAT	1-6の10%	10%													
					15	9	9	9	16	16	9	9	10	17	20
Total					162	97	97	97	171	171	104	104	105	182	215

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.10 Disbursement Schedule of Project Cost (Lakitan area ; 1/3)

No.	Description	Percentage	year	Total Amount	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1	**Direct Cost**													
1.1	Development of DMI Water Facility		31	459	73	1	1	1	50	50	1	1	1	17
1.2	Development of Irrigation Facility		31	986	32	32	32	32	32	32	32	32	32	32
Sub-Total 1				1,445	105	33	33	33	81	81	32	32	32	48
2	**Compensation Cost; =1 *25%**	25%												
2.1	Development of DMI Water Facility		31	115	18	0	0	0	12	12	0	0	0	4
2.2	Development of Irrigation Facility		31	246	8	8	8	8	8	8	8	8	8	8
Sub-total 2				361	26	8	8	8	20	20	8	8	8	12
3	Administration Cost; =(1+2) *10%	10%												
				181	13	4	4	4	10	10	4	4	4	6
4	Engineering Services; =1 *15%	15%												
				217	16	5	5	5	12	12	5	5	5	7
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		132	10	3	3	3	7	7	3	3	3	4
Sub-total 5				132	10	3	3	3	7	7	3	3	3	4
Subtotal (1-5)					170	53	53	53	132	132	52	52	52	78
VAT	1-5の10%	10%												
					17	5	5	5	13	13	5	5	5	8
Total					187	58	58	58	145	145	57	57	57	86
6	Operation & Maintenance *1)													
6.1	Development of DMI Water Facility	-		35	0	15	15	15	15	15	19	19	19	19
6.2	Development of Irrigation Facility	0.5%		5	0	0	0	1	1	1	1	1	1	2
6.3	Development of Irrigation Facility	5.0%		49										
Sub-total 6					0	15	15	16	16	16	20	21	21	21
Subtotal (1-6)					170	68	68	68	147	147	73	73	73	99
VAT	1-6の10%	10%												
					17	7	7	7	15	15	7	7	7	10
Total					187	75	75	75	162	162	80	80	80	109

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.11 Disbursement Schedule of Project Cost (Lakitan area ; 2/3)

No.	Description	Percentage	year	Total Amount	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
1	**Direct Cost**													
1.1	Development of DMI Water Facility		31	459	17	1	1	1	35	35	1	1	1	27
1.2	Development of Irrigation Facility		31	986	32	32	32	32	32	32	32	32	32	32
Sub-Total 1				1,445	48	33	33	33	67	67	33	33	33	59
2	**Compensation Cost; =1 *25%**	25%												
2.1	Development of DMI Water Facility		31	115	4	0	0	0	9	9	0	0	0	7
2.2	Development of Irrigation Facility		31	246	8	8	8	8	8	8	8	8	8	8
Sub-total 2				361	12	8	8	8	17	17	8	8	8	15
3	Administration Cost; =(1+2) *10%	10%												
				181	6	4	4	4	8	8	4	4	4	7
4	Engineering Services; =1 *15%	15%												
				217	7	5	5	5	10	10	5	5	5	9
5	Contingency													
5.1	Price escalation													
5.2	Physical contingency; =(1+2+3+4) *6%													
		6%		132	4	3	3	3	6	6	3	3	3	5
Sub-total 5				132	4	3	3	3	6	6	3	3	3	5
Subtotal (1-5)					78	53	53	53	109	109	53	53	53	95
VAT	1-5の10%	10%												
					8	5	5	5	11	11	5	5	5	9
Total					86	58	58	58	119	119	58	58	58	104
6	Operation & Maintenance *1)													
6.1	Development of DMI Water Facility	-		35	24	24	24	24	24	24	28	28	28	28
6.2	Development of Irrigation Facility	0.5%		5	2	2	2	2	2	3	3	3	3	3
6.3	Development of Irrigation Facility	5.0%		49	16									
Sub-total 6					41	26	26	26	26	26	30	31	31	31
Subtotal (1-6)					119	78	78	79	135	135	83	83	83	126
VAT	1-6の10%	10%												
					12	8	8	8	13	13	8	8	8	13
Total					131	86	86	86	148	148	91	92	92	138

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Table K4.2.12 Disbursement Schedule of Project Cost (Lakitan area ; 3/3)

No.	Description	Percentage	year	Total Amount	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
1	**Direct Cost**														
1.1	Development of DMI Water Facility		31	459	27	1	1	1	31	31	1	1	1	27	27
1.2	Development of Irrigation Facility		31	986	32	32	32	32	32	32	32	32	32	32	32
Sub-Total 1				1,445	59	33	33	33	63	63	33	33	33	59	59
2	**Compensation Cost; =1 *25%**	25%													
2.1	Development of DMI Water Facility		31	115	7	0	0	0	8	8	0	0	0	7	7
2.2	Development of Irrigation Facility		31	246	8	8	8	8	8	8	8	8	8	8	8
Sub-total 2				361	15	8	8	8	16	16	8	8	8	15	15
3	Administration Cost; =(1+2) *10%	10%													
				181	7	4	4	4	8	8	4	4	4	7	7
4	Engineering Services; =1 *15%	15%													
				217	9	5	5	5	9	9	5	5	5	9	9
5	Contingency														
5.1	Price escalation														
5.2	Physical contingency; =(1+2+3+4) *6%														
		6%		132	5	3	3	3	6	6	3	3	3	5	5
Sub-total 5				132	5	3	3	3	6	6	3	3	3	5	5
Subtotal (1-5)					95	53	53	53	102	102	53	53	53	95	95
VAT	1-5の10%	10%													
					9	5	5	5	10	10	5	5	5	9	9
Total					104	58	58	58	112	112	58	58	58	104	104
6	Operation & Maintenance *1)														
6.1	Development of DMI Water Facility	-		35	28	31	31	31	31	31	35	35	35	35	35
6.2	Development of Irrigation Facility	0.5%		5	3	3	4	4	4	4	4	4	5	5	5
6.3	Development of Irrigation Facility	5.0%		49	32										48
Sub-total 6					63	35	35	35	35	35	39	39	39	39	87
Subtotal (1-6)					158	88	88	88	137	137	92	92	92	134	182
VAT	1-6の10%	10%													
					16	9	9	9	14	14	9	9	9	13	18
Total					173	96	96	97	151	151	101	101	101	147	200

*1) No.6.1 to 6.2 costs are for the year, No.6.3 cost is for every 10 years (Column of Total Amount)

Source: JICA Project Team 2

Appendices

Appendix-1: Index of Price Escalation of Construction Materials

Note:
Figures within brackets ( ) under type of construction colomn indicate number of groups represented in that type of construction
Wholesale price indices in 2003-2008 using 2000 as base year (2000=100)
Starting 2009 wholesale price indices using 2005 as base year (2005=100)
1) Change January 2009 over December 2008 using base year 2005 (2005=100)
**) Number of groups represented in that type of construction starting November 2013*
***) Starting November 2013 using 2010 as base year (2010=100)*
****) Average from January to October 2013 using 2005 as base year (2005=100)*

Wholesale Price Indices of Construction Materials, 2017 (2010=100)

Type of Construction	2017												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (26)	133	134	134	135	135	135	135	135	136	137			135
Public Works in Agricultures (15)	131	131	131	132	132	132	132	133	134	135			132
Public Works on Roads, Bridgesb and Ports (23)	127	127	128	128	129	129	129	129	130	131			129
2000=100	443.10	445.13	446.88	448.07	449.86	450.35	450.91	452.66	456.44	458.75			450
Construction of Electricity, Gas, Water, and Communication (21)	131	132	132	132	133	133	133	134	134	135			133
Other Buildings (18)	129	129	129	129	129	129	130	130	131	131			130
General (27)	131	132	132	132	132	133	133	133	134	135			133

Wholesale Price Indices of Construction Materials, 2016 (2010=100)

Type of Construction	2016												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (26)	132	132	132	132	132	132	132	132	133	133	133	133	132
Public Works in Agricultures (15)	129	128	128	128	129	129	129	129	129	129	130	130	129
Public Works on Roads, Bridgesb and Ports (23)	125	125	125	125	125	125	125	125	125	125	126	126	125
2000=100	437.78	437.05	436.57	435.78	436.56	437.57	437.54	437.78	438.10	438.55	439.53	440.83	438
Construction of Electricity, Gas, Water, and Communication (21)	130	130	130	130	130	130	130	130	131	131	131	131	130
Other Buildings (18)	128	128	128	127	128	128	128	128	128	128	129	129	128
General (27)	129	129	129	129	130	130	130	130	130	130	130	131	130

Wholesale Price Indices of Construction Materials, 2015 (2010=100)

Type of Construction	2015												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (26)	129	129	129	130	130	130	130	130	130	131	131	131	130
Public Works in Agricultures (15)	127	126	127	127	127	127	127	127	127	127	128	128	127
Public Works on Roads, Bridgesb and Ports (23)	124	124	124	124	124	124	124	124	125	125	125	125	124
2000=100	433.86	434.28	435.16	434.95	434.81	435.02	434.98	435.47	436.63	436.77	437.36	438.17	436
Construction of Electricity, Gas, Water, and Communication (21)	127	127	127	127	128	128	128	128	128	129	129	130	128
Other Buildings (18)	126	126	126	126	126	126	126	126	127	127	127	128	126
General (27)	127	127	128	128	128	128	128	128	128	129	129	129	128

Wholesale Price Indices of Construction Materials, 2014 (2010=100)

Type of Construction	2014												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (26)	120	121	121	121	122	122	122	123	123	124	124	128	123
Public Works in Agricultures (15)	117	118	118	119	119	120	120	121	121	121	123	126	120
Public Works on Roads, Bridgesb and Ports (23)	116	117	118	118	118	119	119	119	120	120	121	123	119
2000=100	406.28	409.68	411.46	412.97	413.95	415.07	416.08	417.52	418.64	420.39	423.12	431.24	416
Construction of Electricity, Gas, Water, and Communication (21)	117	119	119	120	120	121	121	122	122	122	123	126	121
Other Buildings (18)	117	118	118	119	119	120	120	120	121	121	122	125	120
General (27)	118	119	120	120	120	121	121	121	122	122	123	126	121

Wholesale Price Indices of Construction Materials, 2013 (2005=100)

Type of Construction	2013													Average ***)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	% Change	Nov **)	Dec**)	
Residental and Non Residental Buildings (24) (26 *))	203	203	204	204	205	206	209	209	212	214	0.31	118	119	207
Public Works in Agricultures (23) (15 *))	223	223	224	224	225	227	231	231	235	237	0.44	116	116	228
Public Works on Roads, Bridgesb and Ports (24) (23 *))	220	221	221	222	223	224	227	228	231	233	0.61	115	115	225
2000=100	387.2	388.96	388.96	390.72	392.48	394.24	399.52	401.28	406.56	410.08		402.5	402.5	397
Construction of Electricity, Gas, Water, and Communication (25) (21 *))	197	198	198	198	199	200	203	203	206	208	0.55	115	116	201
Other Buildings (25) (19 *))	210	211	211	211	212	214	217	217	220	222	0.33	116	117	215
General (25) (27 *))	210	210	211	211	212	213	216	217	220	222	0.42	116	117	214

Wholesale Price Indices of Construction Materials, 2012 (2005=100)

Type of Construction	2012												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (24)	197	198	199	200	201	201	201	202	202	202	202	202	201
Public Works in Agricultures (23)	215	216	217	219	219	219	219	220	221	221	222	222	219
Public Works on Roads, Bridgesb and Ports (24)	212	213	215	216	216	217	217	218	218	218	219	219	217
2000=100	373.12	374.88	378.4	380.16	380.16	381.92	381.92	383.68	383.68	383.68	385.44	385.44	381.92
Construction of Electricity, Gas, Water, and Communication (25)	193	193	194	195	195	196	196	196	197	196	197	197	195
Other Buildings (25)	204	204	206	207	207	207	208	208	209	209	209	209	207
General (25)	203	204	205	207	207	207	207	208	209	209	209	209	207

Source: BPS

Wholesale Price Indices of Construction Materials, 2011 (2005=100)

Type of Construction	2011												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (24)	188	190	190	191	192	192	193	194	194	195	195	196	192
Public Works in Agricultures (23)	204	205	206	207	209	208	209	210	211	211	212	213	209
Public Works on Roads, Bridgesb and Ports (24)	202	203	204	205	206	206	207	207	208	209	209	211	206
2000=100	355.52	357.28	359.04	360.8	362.56	362.56	364.32	364.32	366.08	367.84	367.84	371.36	362.56
Construction of Electricity, Gas, Water, and Communication (25)	184	186	186	187	188	188	189	190	190	190	191	192	188
Other Buildings (25)	194	196	197	198	199	199	199	200	201	201	202	203	199
General (25)	193	195	196	197	198	198	198	199	200	200	201	202	198

Wholesale Price Indices of Construction Materials, 2010 (2005=100)

Type of Construction	2010												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (24)	184	184	184	185	186	186	185	185	186	186	186	187	185
Public Works in Agricultures (23)	200	200	200	201	201	201	201	201	201	202	202	203	201
Public Works on Roads, Bridgesb and Ports (24)	197	197	197	198	199	199	199	199	199	199	200	201	199
2000=100	346.72	346.72	346.72	348.48	350.24	350.24	350.24	350.24	350.24	350.24	352	353.76	350.24
Construction of Electricity, Gas, Water, and Communication (25)	180	180	180	181	182	182	182	182	182	182	183	183	181
Other Buildings (25)	190	190	190	191	192	192	191	192	192	192	193	193	192
General (25)	189	189	190	191	191	191	191	191	191	192	192	192	191

Wholesale Price Indices of Construction Materials, 2009 (2005=100)

Type of Construction	% of Change Jan 09	2009												Average
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Residental and Non Residental Buildings (24)	-1.00	180	181	180	180	181	181	182	182	183	182	183	183	182
Public Works in Agricultures (23)	-1.34	193	194	194	194	194	195	196	197	198	198	198	199	196
Public Works on Roads, Bridgesb and Ports (24)	-0.57	192	193	192	192	193	193	194	195	195	195	196	196	194
2000=100		337.92	339.68	337.92	337.92	339.68	339.68	341.44	343.2	343.2	343.2	344.96	344.96	
Construction of Electricity, Gas, Water, and Communication (25)	-0.92	176	176	176	176	176	177	177	178	178	178	179	179	177
Other Buildings (25)	-0.82	184	185	185	185	186	186	187	188	188	188	189	189	187
General (25)	-0.91	185	185	185	185	185	186	186	187	188	188	188	189	186

Wholesale Price Indices of Construction Materials (2000=100), Indonesia, 2008

Type of Construction	2008												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Residental and Non Residental Buildings (22)	239	243	248	251	257	276	282	285	286	287	288	287	269
Public Works in Agricultures (19)	261	265	270	273	280	307	314	319	320	323	323	323	298
Public Works on Roads, Bridgesb and Ports (19)	276	279	285	288	297	327	335	341	342	345	345	345	317
Construction of Electricity, Gas, Water, and Communication (23)	224	228	233	237	244	261	266	269	270	272	274	273	254
Other Buildings (23)	250	253	259	262	269	292	299	302	303	305	307	306	284
General (23)	254	258	263	266	273	297	304	308	309	311	312	311	289

Wholesale Price Indices of Construction Materials (2000=100), Indonesia, 2007

Type of Construction	2007												Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Residental and Non Residental Buildings (22)	209	210	212	214	216	218	219	220	223	225	228	233	219
Public Works in Agricultures (19)	231	233	234	236	239	240	241	242	244	247	249	256	241
Public Works on Roads, Bridgesb and Ports (19)	239	241	242	245	248	250	251	252	255	259	262	269	251
Construction of Electricity, Gas, Water, and Communication (23)	195	197	198	200	201	202	204	204	207	209	212	217	204
Other Buildings (23)	219	221	222	225	227	229	230	231	233	236	239	244	230
General (23)	222	223	225	227	230	231	233	234	236	239	242	248	232

Wholesale Price Indices of Construction Materials (2000=100), Indonesia, 2002 – 2006

Type of Construction	2002	2003	2004	2005	2006												Average
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Residental and Non Residental Buildings (22)	116	122	135	158	183	184	184	185	188	190	192	196	198	200	203	206	192
Public Works in Agricultures (19)	123	132	143	170	205	206	207	208	214	217	218	219	221	223	226	228	216
Public Works on Roads, Bridgesb and Ports (19)	125	135	148	176	211	212	212	214	218	222	224	226	228	231	234	235	222
Construction of Electricity, Gas, Water, and Communication (23)	113	117	129	152	172	173	174	175	179	182	184	185	187	188	191	193	182
Other Buildings (23)	118	126	139	165	192	193	193	194	199	201	203	205	207	209	212	216	202
General (23)	120	128	140	166	195	196	196	197	201	204	206	209	211	213	216	218	205

Source: BPS

Appendix-2: Construction Cost Index by Province for Brantas

Provinsi	Indeks Kemahalan Konstruksi						JAWA TIMUR
	2010	2012	2013	2014	2015	2016	100
ACEH	92.45	91.23	91.61	93.54	97.74	100.14	98.39
SUMATERA UTARA	86.2	92.49	95.92	96.08	102.54	102.76	100.96
SUMATERA BARAT	85.24	88.16	88.72	93	103.01	103.69	101.88
RIAU	96.93	100.82	101.28	102.89	104.97	103.49	101.68
JAMBI	89.31	96.25	96.97	95	96.64	97.99	96.28
SUMATERA SELATAN	87.13	94.42	95.29	99	105.12	106.15	104.29
BENGKULU	87.83	87.47	94.98	96.21	101.64	101.86	100.08
LAMPUNG	83.93	89.85	89.79	91.87	97.57	99.4	97.66
KEP. BANGKA BELITUNG	95.33	104.3	99.59	102.09	104.9	107.64	105.76
KEP. RIAU	101.61	109.81	109.42	107.34	122.33	125.89	123.69
DKI JAKARTA	90.02	93.89	100	97.13	110.13	112.48	110.51
JAWA BARAT	85.04	83.11	89	88.05	101.09	103.79	101.97
JAWA TENGAH	83.44	79.54	85.38	83	95.99	98.96	97.23
DI YOGYAKARTA	83.67	75.79	86.52	84.81	99.06	100.65	98.89
JAWA TIMUR	83.36	81.14	85.94	87.62	100	101.78	100.00
BANTEN	84	87.28	89.25	89.19	101.82	103.66	101.85
BALI	85.53	91.15	93.02	91.67	110.1	113.32	111.34
NUSA TENGGARA BARAT	87.2	78.68	80.01	81	91.8	93.7	92.06
NUSA TENGGARA TIMUR	97.38	85.73	87.67	89.31	97.59	99.82	98.07
KALIMANTAN BARAT	96.61	108.26	107.38	109.46	118.87	117.91	115.85
KALIMANTAN TENGAH	100.83	106.03	100.29	103.23	110.99	106.95	105.08
KALIMANTAN SELATAN	90.46	97.72	97.88	99.18	102.92	103.55	101.74
KALIMANTAN TIMUR	100	108.46	100	100	119.06	117.6	115.54
KALIMANTAN UTARA	–	–	–	109.86	129.56	127.99	125.75
SULAWESI UTARA	98.63	100.46	103	102	110.61	111.62	109.67
SULAWESI TENGAH	90.81	81.72	85	86.62	92.49	95.63	93.96
SULAWESI SELATAN	85.99	86.51	85.89	88.55	96.38	99.11	97.38
SULAWESI TENGGARA	92.17	96.74	96.42	99.67	105.85	107.98	106.09
GORONTALO	90.74	92.1	93.18	93.62	103.05	101.96	100.18
SULAWESI BARAT	89.9	95.53	91.96	94.79	98.46	98.39	96.67
MALUKU	110	100.52	101.02	104.43	119.45	121.76	119.63
MALUKU UTARA	110.43	108.58	115.12	117.89	125.78	127.99	125.75
PAPUA BARAT	142.98	149.15	121.01	125.79	146.01	146.46	143.90
PAPUA	210.1	242.63	189	191.86	247.91	239.98	235.78

Source: BPS

Appendix-3: Dam Construction Cost Data Provided by BBWS-S8

1. Tiga Dadaji Dam (Stage: Detailed Design in 2018)

Direct Construction Cost of the Tiga Dihaji Dam

No.	Work Item	Total Work Cost (million Rp.)
1.	Site Preperation	22,100
		22,100
2.	Main Dam and Cofferdam	2,234,200
3.	Dam Instrumentation	10,100
4.	Jetty and Trashboom	4,500
		2,248,800
6.	Spillway	427,300
7.	Facility Building	18,000
8.	Diversion Building	291,000
9.	Intake Building	109,200
12.	Operation Tools	1,800
	Total construction cost(excluding HP)	3,118,000
5.	Acces Road, Access Inspection, Access Bridge and Road Relocation	114,900
10.	Hydromechanical and Electrical	160,500
11.	Miscellaneous Works	10,300
		285,700
	Total construction cost(including HP)	3,403,800
	Tax 10%	311,800
	Total Cost	3,429,900
	GRAND TOTAL	3,429,900

Source: BBWS-S8

2. Tiga Dadaji Dam (Stage: Feasibility Study in April 2013)

No.	Work Item	Total Work Cost (million Rp.)
A.	**LAND ACQUISITION COST**	
1.	Land acquisition work	35,700
	Total land acquisition cost	35,700
	Sub-total	71,400
B.	**CONSTRUCTION WORK**	
1.	Preparation and access road	3,000
2.	Diversion Channel	442,400
3.	Intake Channel	53,100
4.	Main dam	1,325,000
5.	Spillway	159,200
6.	Floodgate, Stoplog, and Grouting	1,800
	Total construction cost(excluding HP)	1,984,400
	Tax 10%	198,400
	Total Cost	2,218,600
	TOTAL	2,218,600

Source: BBWS-S8

3. Komering I Dam (Stage: feasibility Study in 1982)

No.	Work Item	Total Cost (USD)	Total Work Cost(1982) (million Rp.)
A.	LAND ACQUISITION COST		
1.	Land acquisition work	3,000,000	1,900
	Total land acquisition cost	3,000,000	1,900
			0
B.	CONSTRUCTION WORK		0
1.	Preparation and access road	12,700,000	7,900
2.	Diversion Channel	6,130,000	3,800
3.	Dam and Spillway	41,640,000	26,000
4.	Metal Works (Diversion Gate, Spillway Gate and River Outlet Gate)	4,140,000	2,600
	Total construction cost(excluding HP)	64,610,000	40,400
			0
5.	Engineering Services and Administration Expenses	6,460,000	4,000
6.	Power Facilities	93,910,000	58,700
7.	Physical Contingency	9,690,000	6,100
			0
	Total construction cost(including HP)	177,670,000	111,000
	Tax 10%	17,767,000	11,100
	Total Cost	198,437,000	124,000
	TOTAL	198,437,000	124,000

1 USD = 625IDR (1982)

Source: BBWS-S8

4. Saka Dam (Stage; Feasibility Study in April 2013)

No.	Work Item	Total Work Cost (million Rp.)
1.	Site Preperation	9,400
	Sub-total	9,400
2.	Cofferdam	64,700
3.	Diversion Tunnel	162,400
4.	Main Dam	382,400
	Sub-total	609,500
5.	Spillway	538,600
7.	Measurement Instrumentation and Meteorology	16,400
8.	Facility Building	80,300
9.	Landscape,Slope Reinforcement and Reservoir Cleaning	23,700
	Total construction cost(excluding HP)	1,277,900
6.	Mechanical and Electrical	78,000
	Total construction cost(including HP)	1,355,900
	Tax 10%	135,600
	Total Cost	1,491,500
	TOTAL	1,491,500

Source: BBWS-S8

5. Tanjung Pura Dam (Stage: Pre-Feasibility Study in 2015)

No.	Work Item	Total Work Cost (million Rp.)
1.	Site Preperation	18,200
	Sub-total	18,200
2.	Cofferdam dan Diversion Dam	30,800
3.	Diversion Tunnel	57,500
4.	Main Dam	257,100
	Sub-total	345,400
5.	Spillway	268,200
7.	Measurement Instrumentation and Meteorology	5,000
8.	Acces Road, Access Bridge and Slope Reinforcement	20,500
9.	Facility Building	3,500
10.	Landscape and Reservoir Cleaning	8,000
11.	Irrigation System	14,000
12.	Raw Water System	48,000
	Total construction cost(excluding HP)	730,800
6.	Mechanical and Electrical	19,700
	Total construction cost(including HP)	750,500
	Tax 10%	75,100
	Total Cost	825,600
	TOTAL	825,600

Source: BBWS-S8

6. Buluh Dam (Stage; Pre-Feasibility Study in 2015)

Direct Construction Cost of the Buluh Dam

No.	Work Item	Total Work Cost (million Rp.)
1.	Site Preperation	18,200
	Sub-total	18,200
2.	Cofferdam dan Diversion Dam	30,800
3.	Diversion Tunnel	57,500
4.	Main Dam	286,900
	Sub-total	375,200
5.	Spillway	263,200
7.	Measurement Instrumentation and Meteorology	5,000
8.	Acces Road, Access Bridge and Slope Reinforcement	20,500
9.	Facility Building	3,500
10.	Landscape and Reservoir Cleaning	8,000
11.	Irrigation System	14,000
12.	Raw Water System	48,000
	Total construction cost(excluding HP)	755,600
6.	Mechanical and Electrical	19,700
	Total construction cost(including HP)	775,300
	Tax 10%	77,500
	Total Cost	852,800
	TOTAL	852,800

Source: BBWS-S8

Appendix-4: Index of Price Escalation of Materials of Public Works on Roads, Bridges and Ports

Year	Base year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2019	2010(2013/11)	141	141	141	-	-	-	-	-	-	-	-	-	-
	2000	493.50	493.50	493.50	-	-	-	-	-	-	-	-	-	-
2018	2010(2013/11)	133	133	134	134	135	135	136	136	138	139	140	140	136
	2000	465.50	465.50	469.00	469.00	472.50	472.50	476.00	476.00	483.00	486.50	490.00	490.00	476.29
2017	2010(2013/11)	127	127	128	128	129	129	129	129	130	131	132	132	129
	2000	443.10	445.13	446.88	448.07	449.86	450.35	450.91	452.66	456.44	458.75	462.00	462.00	452.18
2016	2010(2013/11)	125	125	125	125	125	125	125	125	125	125	126	126	125
	2000	437.78	437.05	436.57	435.78	436.56	437.57	437.54	437.78	438.10	438.55	439.53	440.83	437.80
2015	2010(2013/11)	124	124	124	124	124	124	124	124	125	125	125	125	124
	2000	433.86	434.28	435.16	434.95	434.81	435.02	434.98	435.47	436.63	436.77	437.36	438.17	435.62
2014	2010(2013/11)	116	117	118	118	118	119	119	119	120	120	121	123	119
	2000	406.28	409.68	411.46	412.97	413.95	415.07	416.08	417.52	418.64	420.39	423.12	431.24	416.36
2013	2005(2009/1)	220	221	221	222	223	224	227	228	231	233	115	115	225
	2000	387.2	388.96	388.96	390.72	392.48	394.24	399.52	401.28	406.56	410.08	402.5	402.5	397.08
2012	2005(2009/1)	212	213	215	216	216	217	217	218	218	218	219	219	217
	2000	373.12	374.88	378.4	380.16	380.16	381.92	381.92	383.68	383.68	383.68	385.44	385.44	381.92
2011	2005(2009/1)	202	203	204	205	206	206	207	207	208	209	209	211	206
	2000	355.52	357.28	359.04	360.8	362.56	362.56	364.32	364.32	366.08	367.84	367.84	371.36	362.56
2010	2005(2009/1)	197	197	197	198	199	199	199	199	199	199	200	201	199
	2000	346.72	346.72	346.72	348.48	350.24	350.24	350.24	350.24	350.24	350.24	352	353.76	350.24
2009	2005(2009/1)	192	193	192	192	193	193	194	195	195	195	196	196	194
	2000	337.92	339.68	337.92	337.92	339.68	339.68	341.44	343.2	343.2	343.2	344.96	344.96	341.44
2008	2000	276	279	285	288	297	327	335	341	342	345	345	345	317
2007	2000	239	241	242	245	248	250	251	252	255	259	262	269	251
2006	2000	211	212	212	214	218	222	224	226	228	231	234	235	222
2005	2000													176
2004	2000													148
2003	2000													135
2002	2000													125
2000	1982													663.3

Note: Base year is 2000.
Escalation is estimated from inflation rate of public investment (website of Statistics Indonesia (BPS), https://www.bps.go.id/subject/4/konstruksi.html#subjekViewTab3)).

Source: BPS

Appendix-5: Construction Cost Index by Province for South Sumatra

Provinsi	Indeks Kemahalan Konstruksi								SUMATERA SELATAN
	2010	2012	2013	2014	2015	2016	2017	2018	100
ACEH	92.45	91.23	91.61	93.54	97.74	100.1	96.41	100.4	102.82
SUMATERA UTARA	86.2	92.49	95.92	96.08	102.5	102.8	101.5	101.5	103.92
SUMATERA BARAT	85.24	88.16	88.72	93	103	103.7	95.33	99.1	101.50
RIAU	96.93	100.8	101.3	102.9	105	103.5	94.73	96.86	99.20
JAMBI	89.31	96.25	96.97	95	96.64	97.99	88.39	92.53	94.77
SUMATERA SELATAN	87.13	94.42	95.29	99	105.1	106.2	98.64	97.64	100
BENGKULU	87.83	87.47	94.98	96.21	101.6	101.9	93.27	96.76	99.10
LAMPUNG	83.93	89.85	89.79	91.87	97.57	99.4	90.09	89.31	91.47
KEP. BANGKA BELITUNG	95.33	104.3	99.59	102.1	104.9	107.6	101.7	99.29	101.69
KEP. RIAU	101.6	109.8	109.4	107.3	122.3	125.9	122.7	127.7	130.79
DKI JAKARTA	90.02	93.89	100	97.13	110.1	112.5	117.6	109.1	111.78
JAWA BARAT	85.04	83.11	89	88.05	101.1	103.8	96.78	103.6	106.13
JAWA TENGAH	83.44	79.54	85.38	83	95.99	98.96	93.05	98.64	101.02
DI YOGYAKARTA	83.67	75.79	86.52	84.81	99.06	100.7	92.52	104.9	107.41
JAWA TIMUR	83.36	81.14	85.94	87.62	100	101.8	97.5	103.9	106.37
BANTEN	84	87.28	89.25	89.19	101.8	103.7	97.88	100.2	102.64
BALI	85.53	91.15	93.02	91.67	110.1	113.3	111.6	123	125.92
NUSA TENGGARA BARAT	87.2	78.68	80.01	81	91.8	93.7	91.63	100.8	103.20
NUSA TENGGARA TIMUR	97.38	85.73	87.67	89.31	97.59	99.82	95.94	99.79	102.20
KALIMANTAN BARAT	96.61	108.3	107.4	109.5	118.9	117.9	109.1	114	116.70
KALIMANTAN TENGAH	100.8	106	100.3	103.2	111	107	97.47	102.3	104.78
KALIMANTAN SELATAN	90.46	97.72	97.88	99.18	102.9	103.6	101.7	105.1	107.63
KALIMANTAN TIMUR	100	108.5	100	100	119.1	117.6	109.2	114.1	116.89
KALIMANTAN UTARA	-	-	-	109.9	129.6	128	118.3	113.3	115.99
SULAWESI UTARA	98.63	100.5	103	102	110.6	111.6	112.1	110.8	113.51
SULAWESI TENGAH	90.81	81.72	85	86.62	92.49	95.63	88.13	97.04	99.39
SULAWESI SELATAN	85.99	86.51	85.89	88.55	96.38	99.11	95.57	101.7	104.15
SULAWESI TENGGARA	92.17	96.74	96.42	99.67	105.9	108	99.75	102	104.42
GORONTALO	90.74	92.1	93.18	93.62	103.1	102	92.76	96.46	98.79
SULAWESI BARAT	89.9	95.53	91.96	94.79	98.46	98.39	88.61	91.33	93.54
MALUKU	110	100.5	101	104.4	119.5	121.8	121.1	126.4	129.44
MALUKU UTARA	110.4	108.6	115.1	117.9	125.8	128	120.9	116.6	119.37
PAPUA BARAT	143	149.2	121	125.8	146	146.5	140	134	137.26
PAPUA	210.1	242.6	189	191.9	247.9	240	229.8	227.9	233.41

Source: BPS

Supporting Report L

ECONOMIC ANALYSIS AND PROJECT EVALUATION

Abbreviations

EIRR	Economic Internal Rate of Return
MILT	Ministry of Land, Infrastructure, Transportation and Tourism
PDAM	Perusahaan Daerah Air Minum (Regional Water Company)
PLN	Perusahaan Listrik Negara (State-owned company supplying the electricity)

The Republic of Indonesia

THE PROJECT
FOR
ASSESSING AND INTEGRATING CLIMATE CHANGE IMPACTS INTO THE WATER RESOURCES MANAGEMENT PLANS FOR BRANTAS AND MUSI RIVER BASINS
(WATER RESOURCES MANAGEMENT PLAN)

FINAL REPORT

Supporting Report L : ECONOMIC ANALYSIS AND PROJECT EVALUATION

Abbreviations

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PART 1 BRANTAS RIVER BASIN

CHAPTER L1 ECONOMIC ANALYSIS AND PROJECT EVALUATION（BRANTAS RIVER BASIN）

L1.1 Economic Analysis of Flood Control Project

L1.1.1 General

(1) Methodology of the Analysis

Economic evaluation aims at measuring the economic impact of the project from viewpoint of national economy as regard to the Flood Control Project is conducted. The main objective of the analysis here is to examine the economic feasibility of each structural measures under three climate scenarios and four river basins.

As there is no manual or guideline for economic analysis of flood protection sector in Indonesia, the economic evaluation is conducted based on the "Manual of Economical Investigation of Flood Disaster" developed by the Ministry of Land, Infrastructure and Transportation and Tourism (MILT), in Japan.

(2) Flood Damage Estimation

Basically, the reduced flood damages of many kinds of assets influenced by the project implementation are considered as the economic benefits of the project. Based on this manual, flood damages are broadly divided into categories of direct damages and indirect damages. Direct damages are physical damage on assets and crops caused by flood, while indirect damages are other economic losses such as suspension of economic activities, etc. Categorization of damage items by the manual and the quantified economic damages in this study are shown in Table L1.1.1.

Table L1.1.1 Major Direct and Indirect Damage

Categorization of Damage	Damage Item	Calculation in this analysis
Direct Damage	House	Done
	Household asset	Done
	Fixed asset for Business Use	-
	Stock asset for Business Use	-
	Fixed asset for Agricultural and Fishery Household Use	-
	Stock asset for Agricultural and Fishery Household Use	-
	Agricultural Crops	Done
	Infrastructure	Done
Indirect Damage	Operation Loss of Enterprise due to Business Suspension	Done, assumed at 10% of Direct Damage
	Income Loss of the Household due to the Expense from the Flood	
	Suspension of Transportation	
	Economic Loss by Suspension of Lifeline	
	Mental Damage by Flood	

Source: JICA Project Team 2

(3) Estimation of Expected Annual Average of Damage Reduction

To estimate "expected annual average damage reduction", firstly "avoided damage by project" in each return period is calculated; secondly "average damage reduction" and "provability" of each return period are multiplied to calculate the "annual average damage reduction".

The "expected annual average damage reduction", which shows the difference of damage under "With" and "Without" case scenario will be the economic benefit in the calculation of EIRR.

Table L1.1.2 Estimation Method of Expected Annual Average of Damage Reduction under "With Case" and "Without Case"

Return Period	Flood Damage			Avoided Damage Reduction	Provability	Annual Average Damage Reduction
	Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)			
1 year			D0=0			
				(D0+D1)/2	1-(1/2)= 0.500	d1=(D0+D1)/2 x 0.500
2 years	L1	L2	D1=L1-L2			
				(D1+D2)/2	(1/2)-(1/5)= 0.300	d2=(D1+D2)/2 x 0.300
5 years	L3	L4	D2=L3-L4			
				(D2+D3)/2	(1/5)-(1/10)= 0.100	d3=(D2+D3)/2 x 0.100
10 years	L5	L6	D3=L5-L6			
				(D3+D4)/2	(1/10)-(1/20)= 0.050	d4=(D3+D4)/2 x 0.050
20 years	L7	L8	D4=L7-L8			
				(D4+D5)/2	(1/20)-(1/30)= 0.017	d5=(D4+D5)/2 x 0.017
30 years	L9	L10	D5=L9-L10			
				(D5+D6)/2	(1/30)- (1/50)= 0.013	d6=(D5+D6)/2 x 0.013
50 years	L11	L12	D6=L11-L12			
				(D6+D7)/2	(1/50)-(1/100)=0.010	d7=(D6+D7)/2 x 0.010
100 years	L13	L14	D7=L13-L14			
Expected Annual Average Damage Reduction			d1+d2+d3+d4+d5+d6+d7			

Source: JICA Project Team 2

(4) Structural Measures in the Project

Structural measures in this project are constructing of new dikes and heightening of dikes, as described in L1-2 Economic Analysis (Flood Control Project) in Data Table for Supporting Report L as economic direct cost（Heightening of Dike/Dike Construction）, and economic operation and maintenance cost. In this chapter, 12 of economic analyses, under four river basins (Widas, Sadar, Ngotok, Tawing) in three climate scenarios (Low, Medium, High) are conducted.

(5) The Direct Cost and Benefit

The direct cost and benefit of this project is as following Table L1.1.3 and details are explained in this chapter. Detail of economic cost, economic benefit and calculation are shown in L1-2 Economic Analysis (Flood Control Project) in Data Table for Supporting Report L.

Table L1.1.3 Direct Cost and Benefit of Flood Control Project

Direct Cost	Benefit
• Constructing of new Dike • Heightening of Dike	• Reduction of Damage to House • Reduction of Damage to Household Asset • Reduction of Damage to Agricultural Crop • Reduction of Damage to Infrastructure • Reduction of Indirect Damage

Source: JICA Project Team 2

L1.1.2 Calculation Method of Each Damage

(1) Damage to Houses

Damage of household asset is calculated by the formula below.

"Number of Affected House" x "Average Value of House" x "Damage Rate"

"Number of Affected House" is estimated by the inundation analysis per river basin under each return period cases.

"Average Value of House" is assumed by the interview to several real-estate developers in each urban and rural area as the statistical data of house value is not available in the study area. Considering the social condition of the study area, the average houses are assumed to be in Batu Bata (red brick) structure and the floor area is 45m^2. Based on the interviews, the values of newly constructed houses are at IDR137,500,000 in urban area and at IDR125,000,000 in rural area. Generally, the value of houses decreases as time flows after the construction. The average residual value is assumed at 40% of the construction price as shown in Table L1.1.4.

Table L1.1.4 Values of House by the Interview of Developers

	Urban Area	Rural Area
Average Construction Price	IDR 137,500,000	IDR 125,000,000
Average Value of House	IDR 55,000,000	IDR 50,000,000
Area	Malang City, Surabaya City, Mojokerto City, Sidoarjo Regency	Malang Regency, Batu City, Biltar City, Kediri City and Regency, Nganjuk Regency, Tulungagung Regency, Jombang Regency

Source: JICA Project Team 2

"Damage Rate" is quoted from the Japanese manual. The average water level of whole flood area is used to determine the damage rate as shown in Table L1.1.5.

Table L1.1.5 Damage Rate for Residential Building by Inundation Depth

Inundation Depth	Gradient	< 0.5 m	0.5 – 0.99 m	1.0 – 1.99 m	2.0 – 2.99 m	3.0 m <
Damage Rate of Residential Building	<1/1000	0.092	0.119	0.266	0.580	0.834
	1/1000~1/500	0.126	0.176	0.343	0.647	0.870
	1/500 <	0.144	0.205	0.382	0.681	0.888

Source: Manual of Economical Investigation of Flood Disaster, MILT, Japan, 2005 April

(2) Damage to Household Asset

Damage of household assets of electric appliances such as TV, refrigerator, radio and other furniture are assumed at 10% of the damage to house.

"Damage to House" x 10%

(3) Damage to Agricultural Crops

Damage to agricultural crops is calculated by the following formula.

"Damaged Area of Agricultural Field" x "Crop Yield" x "Economic Value of Paddy and Maize" x "Damage Rate"

"Damaged Area of Agricultural Field" is estimated by the inundation analysis under each return period cases. Only the paddy is assumed to be damaged by flood in the project area as the food occurs in rainy season when paddy is cultivated.

"Crop Yield" is 6.41t/ha calculated by JICA Project Team 2.

"Unit Economic Value of Paddy and Maize" is estimated by assuming the rice made in

Thailand is imported and transported to the project area. The price of the rice is quoted by the price forecast in 2030 made by the World Bank (Commodity Market Outlook, April 2017, World Bank). As the result, IDR2,838/kg is used as an economic farm gate price of paddy as estimated in Table L1.1.6.

Table L1.1.6 Economic Price of Paddy

		Import Parity		
		Calculation	US$/ton	IDR/Kg
1.	Price Forecast of rice, Bangkok, Thailand, f.o.b.		344.0	
2.	Quality Adjustment 95 (10% broken)		326.8	
3.	Insurance, freight, etc.		30.0	
4.	Forecast 2017 c.i.f. price of rice, Jakarta		356.8	
				4,774
5.	Port handling, storage and losses	5% +		239
6.	Transportation (port to wholesaler)	+		209
7.	Ex-wholesaler price			5,221
8.	Marketing Margin	10% -		522
9.	Local transportation (village to wholesaler)	-		200
10.	Value of Milled Rice			4,499
11.	Conversion of Paddy	65%		2,924
12.	Milling Cost	-		68
13.	Revenue of Rice Bran	+		150
14.	Transportation and Stabilization of Rice Bran	-		68
15.	Local transportation (farm to village)	-		100
16.	Economic farm gate price			**2,838**

Source: Calculated by JICA Project Team 2 based on the price of Commodity Market Outlook, April 2017, World Bank

"Damage Rate" is quoted from the Japanese manual as shown in Table L1.1.7.

Table L1.1.7 Damage Rate for Agricultural Crops by Inundation Depth

Duration of Inundation (Day)	Depth of Inundation (m)	1 to 2	3 to 4	5 to 6	More than 7
Damage Rate of Agricultural Crops	<0.5	0.21	0.30	0.36	0.50
	0.5~0.99	0.24	0.44	0.50	0.71
	1<	0.37	0.54	0.64	0.74

Source: Manual of Economical Investigation of Flood Disaster, MLIT, Japan, 2005 April

(4) Damage to Infrastructure

It is difficult to estimate the damage of infrastructure in Indonesia, so the methodology adopted in the Japanese manual is used.

"Direct Damage to House and Household Asset" x 131.1%

The category of infrastructure affected by the flood is assumed as road, bridge and agricultural facility. Referring to the Japanese manual, the damage of those facilities was 131.1% of direct damage of houses and household asset as shown in Table L1.1.8, therefore the 131.1% is added as damage of infrastructure.

Table L1.1.8 Ratio of Infrastructure Damage against General Asset Damage (%)

Facility	Road	Bridge	Agricultural Facility	Sum
Damage ratio	61.6%	3.7%	65.8%	131.1%

Source: The Manual of Economical Investigation of Flood Disaster, MLIT, Japan, 2005 April

(5) Indirect Damage

"Direct Damage" x 10%

In addition to the direct damage, indirect damage which corresponds to economic loss of stop of businesses and house works, suspension of transportation and lifeline services, etc. is there. The indirect damages are assumed at 10% of direct damage based on the interviews to the experts and other project report conducted in the study area.

L1.1.3 Condition of the Analysis

All prices and costs are expressed in Indonesia Rupiah (IDR). Benefits and costs are evaluated from the commencement of the project until 50 years after completion of the construction in each analysis, which is commonly applied to a flood control project.

Assumptions of the economic evaluation for flood control project are as follows:

- Each family lives in one house.
- Number of family members remain the same at current rate.
- Population is stable after 2050 in each regency and city.
- The damaged agricultural crop is only paddy as the flood assume to happen in rainy season when paddy is cultivated.
- For determining the damage rate, inundation depth is assumed at the average depth in inundation area.
- Social discount rate is at 10%, which is commonly used in Indonesia.

L1.1.4 Economic Cost of the Project

(1) Capital Investment Costs

The cost component consists of i) Direct Construction Cost, ii) Compensation Cost, iii) Administration Cost, iv) Engineering Service Cost, and v) Physical Contingency. Price contingency is excluded. Transfer payment such as tax and subsidies are also excluded from economic cost.

Whole financial project cost is assumed to be local currency portion, and the standard conversion factor at 0.9 is applied to convert into economic cost.

The economic costs of the projects in each river basin are estimated as shown in Table L1.1.9.

(2) Operation and Maintenance Costs for Civil Structures

The annual operation and maintenance (O&M) cost is assumed to be at 0.5% of direct construction cost after the construction.

Table L1.1.9 Economic Cost of the Project

unit: billion IDR

Scenario	River Basin	Total Cost*1	Initial Investment Cost								O&M Cost*2
			2039	2040	2041	2042	2043	2044	2045	2046	
Low	Widas	106.1	0.0	0.0	0.0	0.4	4.9	22.1	57.1	0.4	21.2
	Ngotok	23.0	0.0	0.0	0.0	0.1	5.3	11.2	1.8	0.1	4.6
	Sadar	5.1	0.0	0.0	0.0	0.0	0.2	0.1	1.3	2.4	1.1
	Tawing	62.0	0.0	0.0	0.0	11.7	31.5	1.5	4.7	0.2	12.4
Medium	Widas	106.1	0.4	4.9	23.9	55.3	0.3	0.0	0.0	0.0	21.2
	Ngotok	63.2	0.2	14.6	31.8	3.8	0.2	0.0	0.0	0.0	12.6
	Sadar	5.1	0.0	0.2	0.2	1.2	2.4	0.0	0.0	0.0	1.0
	Tawing	75.9	14.3	38.5	3.1	4.6	0.2	0.0	0.0	0.0	15.2
High	Widas	104.1	0.2	3.0	26.5	53.0	0.6	0.0	0.0	0.0	20.8
	Ngotok	147.4	0.3	31.5	78.4	6.9	0.8	0.0	0.0	0.0	29.5
	Sadar	11.9	0.0	0.3	0.8	2.8	5.6	0.0	0.0	0.0	2.4
	Tawing	51.3	9.6	25.2	3.6	2.4	0.3	0.0	0.0	0.0	10.3

*1: Total cost for the entire period of the project

*2: Total O&M cost for the entire period of the project

Source: JICA Project Team 2

L1.1.5 Definition and Methodology for Calculation of Economic Benefit

(1) Definition of Economic Benefits

The benefit to be obtained by implementing the flood control project is defined as the reduction of economic damages resulting from flood. Reduction of flood damage in each basin is estimated by comparing “With Case” and “Without Case” of the flood control project in the concerned basins. The difference of damage between “With Case” and “Without Case” is the benefit of this project.

(2) Calculation of Economic Benefit

In this analysis, the following four direct benefits and an indirect benefit shown in Table L1.1.10 are evaluated. Calculation method of each item is explained in Section L1.1.1. The calculation of expected annual average damage reduction using the following damage reductions are shown in L1-1 Flood Damage Estimation in Data Table for Supporting Report L.

1) Reduction of Damage to House
2) Reduction of Damage to Household Asset
3) Reduction of Damage to Agricultural Crop
4) Reduction of Damage to Infrastructure
5) Indirect Damage

The result of total economic benefits of this project are summarized in Table L.1.1.10.

Table L1.1.10 Economic Benefit of the Flood Control Project for the Entire Period of the Project

unit: billion IDR

Scenario	River Basin	Total Benefit
Low	Widas	188.4
	Ngotok	920.8
	Sadar	527.0
	Tawing	178.4
Medium	Widas	285.8
	Ngotok	1,459.2
	Sadar	523.9
	Tawing	179.6
High	Widas	407.3
	Ngotok	2,690.9
	Sadar	558.8
	Tawing	163.9

Source: JICA Project Team 2

L1.1.6 Results of Economic Analysis

Results of the economic evaluation are summarized in Table L1.1.11 and the detail calculation are presented in L1-2 Economic Analysis (Flood Control Project) in Data Table for Supporting Report L.

Table L1.1.11 Summary of Economic Evaluation

Scenario	River Basin	EIRR (%)	NPV (Billion IDR)	B/C
Low	Widas	3.0%	-31	0.4
	Ngotok	82.7%	101	9.3
	Sadar	118.4%	51	22.9
	Tawing	6.4%	-12	0.7
Medium	Widas	5.7%	-27	0.6
	Ngotok	50.9%	194	5.3
	Sadar	117.6%	68	23.0
	Tawing	4.9%	-26	0.6
High	Widas	8.8%	-8	0.9
	Ngotok	41.3%	337	4.2
	Sadar	74.4%	68	10.5
	Tawing	7.2%	-10	0.8

Source: JICA Project Team 2

Findings of economic evaluation is summarized as follows:

- Under the proposed measures for the Ngotok, and Sadar River Basins, EIRR became considerably high in all cases. Those proposed measures are economically feasible.
- In case of measures for Widas and Tawing River Basins, the EIRR values become lower than the minimum required rate generally used by donors, which is at 9-12%. Therefore, it is recommended that the plans should be reviewed and/or modified as needed.
- This analysis is a rough estimation as it is difficult to forecast the future climate change. Considering the result of economic evaluation of four river basins, there are so much difference among them. It is recommended that these plans should be monitored periodically, as reflecting the current climate data and other social situation in the future.

L1.1.7 Possible Fund Source of the Project

Most of fund sources of the measures proposed in this project have not been decided. In general,

the most probable fund source of these measures would be APBN as the construction or heightening of dike is normally not funded by donors considering the fact that the necessary fund amount is comparatively small and high technical knowledge is not needed.

In order to secure the APBN, necessary procedures should be followed.

L1.2 Economic Analysis of Water Supply Project

L1.2.1 General

Economic evaluation aims at measuring the economic impact of the project from viewpoint of national economy as regard to the Water Supply project is conducted. The main objective of the analysis here is to examine the economic feasibility of the adaption measures regarding increasing water supply (constructing dams and recycling plant for sewage water) and saving water loss (distribution of pipeline of PDAMs, rehabilitation of irrigation facility).

In this chapter, three of economic analyses under three climate scenarios (Low, Medium, High) are conducted.

The direct cost and benefit of this project is shown in Table L1.2.1 and details are explained in this chapter. Detail of economic cost, economic benefit and calculation are shown in L1-3 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

Table L1.2.1 Direct Cost and Benefit of Water Supply Project

Direct Cost	Benefit
• Construction of Dam • Rehabilitation of Irrigation Facility • Replacement of PDAM Pipeline • Construction of Recycling Plant for Sewage Water	• Incremental Water Usage for Irrigation • Incremental Water Usage for Households and Factory through PDAM • Incremental Water Usage for Factories by PJT1(not through PDAM) • Incremental Hydro Power Generation

Source: JICA Project Team 2

L1.2.2 Conditions of the Analysis

General conditions adopted for this project are the same as those for flood control project described in the Section L1.1.2.

All prices and costs are expressed in Indonesia Rupiah (IDR). Benefits and costs are evaluated from the commencement of the project until 50 years after completion of the construction in each analysis, which is commonly applied to water supply project.

L1.2.3 Economic Cost of the Project

(1) Capital Investment Costs

The cost component consists of i) Direct Construction Cost, ii) Compensation Cost, iii) Administration Cost, iv) Engineering Service Cost, andv) Physical Contingency. Price contingency is excluded. Transfer payment such as tax and subsidies are also excluded from economic cost.

Whole financial project cost is assumed to be local currency portion, and the standard conversion factor at 0.9 is applied to convert into economic cost.

The economic costs of the projects under each climate scenario are estimated as shown in Table L1.2.2

Table L1.2.2 Economic Cost of Water Supply Project for the Entire Period of the Project

unit: billion IDR

Scenario	Dam Construction /Heightening of Dam	Rehabilitation of Irrigation Canals	Rehabilitation of Pipeline of PDAMs	Recycling Plant for Sewage Water	Compensation Cost, Administration Cost, Engineering Service, Physical Contingency*1	O&M Cost	Total Cost
Low	3,615.3	2,008.9	333.2	287.7	3,562.6	2,450.0	12,257.7
Medium	6,320.7	2,008.9	333.2	287.7	5,591.0	3,635.0	18,176.6
High	7,205.4	2,008.9	333.2	287.7	6,254.6	4,022.5	20,112.3

Source: JICA Project Team 2

(2) Operation and Maintenance Costs for Civil Structures

The annual operation and maintenance (O&M) cost is assumed to be at 0.5% of direct construction cost after the construction.

L1.2.4 Definition and Methodology for Calculation of Economic Benefit

(1) Definition of Economic Benefits

The benefit to be obtained by implementing the water supply project is defined as the reduction of economic damages resulting from drought. Reduction of drought damage under each climate scenario is estimated by comparing "With Case" and "Without Case" of the water supply project. The difference of damage between "With Case" and "Without Case" is the benefit of this project.

(2) Calculation of Economic Benefit

Under With case scenario, more water is supplied than the Without case by reducing the probability of drought. The increased water amount enables to make the following four benefits.

a) Incremental Water Usage for Irrigation
b) Incremental Water Usage for Households and Factory through PDAM
c) Incremental Water Usage for Factories by PJT1(not through PDAM)
d) Incremental Amount of Hydro Power Generation

Calculation methods of each item are explained below.

a) Incremental Water Usage for Irrigation

"Incremental Area of Agricultural Field" x "Crop Yield " x "Unit Economic Value of Paddy and Maize"

Under with case, part of economic damage caused by draught is avoided by the structural measures. The economic benefit is calculated by the above formula.

The drought is assumed to occur both in rainy season and dry season. In rainy season, only the paddy is cultivated. In dry season, paddy is cultivated in the first stage, and maize is cultivated in the second stage.

"Incremental Area of Agricultural Field" (difference with and without case scenario) is summarized in Table L1.2.3 calculated by the JICA Project Team 2. Economic benefit by structural measures is estimated from the economic price of paddy and maize. These remains the same during whole evaluation period.

Table L1.2.3 Incremental Crop Yield of Agricultural Field

unit: ton

	Climate Scenario	Wet Season (Paddy)	Dry Season 1 (Paddy)	Dry Season 2 (Maize)
Crop Yield per Hectare per Year	Low	760	126,186	53,002
	Medium	15,548	129,047	33,674
	High	50,008	206,024	96,447

Source: JICA Project Team 2

"Crop Yield" is calculated by JICA Project Team 2 shown in Table L1.2.4. Crop Yield is assumed to be same under each climate scenario.

Table L1.2.4 Crop Yield per Year of Paddy and Maize

unit: t/ha

	Wet Season (Paddy)	Dry Season 1 (Paddy)	Dry Season 2 (Maize)
Crop Yield	6.413	5.834	7.324

Source: JICA Project Team 2

"Unit Economic Value of Paddy and Maize" are estimated by assuming those are imported from Thailand and America as shown in the Table L1.2.5 and Table L1.2.6. The latest price forecast data in 2030 of World Bank (Commodity Market Outlook, April 2017, World Bank) is used for the price of crops.

The economic price of Paddy is estimated at IDR2,838/kg and that of maize becomes IDR 2,467/kg.

Table L1.2.5 Calculation of Economic Price of Paddy

		Import Parity		
		Operation	**US$/ton**	**IDR/kg**
1.	**Price Forecast of rice, Bangkok, Thailand, f.o.b.**		**344.0**	
2.	**Quality Adjustment 95 (10% broken)**		**326.8**	
3.	**Insurance, freight, etc.**		**30.0**	
4.	**Forecast 2017 c.i.f. price of rice, Jakarta**		**356.8**	
				4,774
5.	**Port handling, storage and losses**	**5% +**		**239**
6.	**Transportation (port to wholesaler)**	**+**		**209**
7.	**Ex-wholesaler price**			**5,221**
8.	**Marketing Margin**	**10% -**		**522**
9.	**Local transportation (village to wholesaler)**	**-**		**200**
10.	**Value of Milled Rice**			**4,499**
11.	**Conversion of Paddy**	**65%**		**2,924**
12.	**Milling Cost**	**-**		**68**
13.	**Revenue of Rice Bran**	**+**		**150**
14.	**Transportation and Stabilization of Rice Bran**	**-**		**68**
15.	**Local transportation (farm to village)**	**-**		**100**
16.	**Economic farm gate price**			**2,838**

Source: Calculated by JICA Project Team 2 on the basis of the information of Commodity Market Outlook, April 2017, World Bank

Table L1.2.6 Calculation of Economic Price of Maize

		Import Parity		
		Operation	**US$/ton**	**IDR/kg**
1.	**Price Forecast of maize, Gulf Ports, USA, f.o.b.**		**164.0**	
2.	**Insurance, freight, etc.**		**40.0**	
3.	**Forecast 2017 c.i.f. price of maize, Jakarta**		**204.0**	
4.				**2,729**
	Port handling, storage and losses	**5% +**		**136**
5.	**Transportation (port to wholesaler)**	**+**		**209**
6.	**Ex-wholesaler price**			**3,075**
7.	**Marketing Margin**	**10% -**		**307**
8.	**Local transportation (village to wholesaler)**	**-**		**200**
9.	**Local transportation (farm to village)**	**-**		**100**
10.	**Economic farm gate price**			**2,467**

Source: Calculated by JICA Project Team 2 on the basis of the information of Commodity Market Outlook, April 2017, World Bank

The result of benefit calculation in each case is shown in Economic Analysis in L1-3 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

b) Incremental Water Usage for Households and Factory through PDAM

"Incremental Water Volume through PDAM" x "Unit Economic Value of Water"

The difference of possible water usage between With and Without cases makes the benefit of the project.

"Unit Economic Value of Water" is basically estimated by quantifying the willingness to pay of users which is estimated based on interview survey. However, there is no available data of willingness to pay in the study area to be referred, therefore the average water tariff of PDAM is used alternatively as the economic unit value of water use.

The average tariff rates of domestic users and industrial users in 2016 are calculated from the answers from three PDAMs as shown in Table L1.2.7.

To provide the said incremental water volume to users, PDAM needs to treat and supply water. The additional cost is also added in the calculation by estimating the average water production cost which includes the typical construction and O&M costs for life period of the facility as shown in Table L1.2.8. The average cost is estimated at IDR3,517. Therefore, the actual average tariff for PDAM users is as shown in Table L1.2.7.

Table L1.2.7 Average Tariff and Actual Economic Value of PDAM

unit: IDR/m^3

		Domestic	Industry
A	Average Tariff for PDAM Users	3,859	12,277
B	Production Cost of Water	3,517	3,517
c=a-b	Surplus of Water for PDAM Users	342	8,760

Source: Questionnaire to PDAMs (Malang, Sidoarjo, Mojokerto)

Table L1.2.8 The Calculation of PDAM Water Purification Cost

	Capital Cost *			O&M Cost *	* JICA Survey Team assumptions
WTP Cost	WTP construction cost/m3:IDR	5,336,728	Unit O&M Cost	2,001 IDR/m^3	
	WTP Water Production m3/Day:IDR	589,248	Monthly O&M Cost	35.4 Billion IDR/month	
	Total Capital Cost:Billion IDR (WTP Construction)	3,144.7			

Estimation of Average Cost	Capital Cost	Capital Recovery Factor	Average Capital Cost	O&M Cost	Total Cost	Monthly Water Consumption	Average Cost of Water
	Billion IDR	DR = 10%, 40Years	Billion IDR/month	Billion IDR/month	Billion IDR/month	(m3)	(IDR/m3)
	3,144.7	0.102	26.8	35.4	62.2	17,677,440.0	3,517

Source: JICA Project Team 2

In the actual calculation of economic analysis, the water volume of PDAM is the same under "With Case" and "Without Case" as the water use of PDAM is prioritized over other water use such as factories and irrigation. Therefore, there is no benefit of the incremental water use through PDAM in each climate scenario for both cases of domestic and industry water supply.

The result of benefit calculation in each case is shown in Economic Analysis in L1-3 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

c) Incremental water usage for factories by PJT1(not through PDAM)

"Incremental Water Volume by PJT1" x "Unit Economic Value of Water"

Water of industry use is directly provided from PJT1 to some factories. Under without case scenario, this water amount is reduced when drought occurs.

"Incremental Water Volume by PJT1", difference of water volume is supplied to Factories by PJT1 under with and without case, is shown in Table L1.2.9.

Table L1.2.9 Incremental Water Volume by PJT1

unit m^3/day

	Climate Scenario	Water Volume
Incremental Water Volume by PJT1	Low	589,248
	Medium	88,128
	High	0

Source: JICA Project Team 2

"Unit Economic Value of Water" is basically estimated by quantifying the willingness to pay of users as explained, however, the willingness to pay of industrial users and production cost of water by PJT1 is not available, therefore the economic value of water and average production cost are assumed in the same way as those of PDAMs. The result is shown in the following Table L1.2.10.

Table L1.2.10 Average Tariff and Actual Economic Value of PDAM

unit: IDR/m^3

	Industry Users	Economic Value
A	Average Tariff for Industry Users	12,277
B	Production Cost of Water	3,517
c=a-b	Surplus of Water for Industry Users	8,760

Source: JICA Project Team 2

The result of benefit calculation in each case is shown in Economic Analysis in L1-3 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

d) Incremental Amount of Hydro Power Generation

"Incremental Hydro Power Generation" x "Unit Alternative Electricity Cost (Thermal Power Generation)"

Under without case scenario, the hydro power generation is reduced by the occurrence of drought. However, it is assumed that the same amount of electricity is provided considering social demand. Under this circumstance, thermal power generation would be used instead of hydro power generation. O&M cost of thermal power generation is much higher than that of hydro power generation which can be negligibly low. Therefore "Incremental Amount of Hydro Power Generation" x "Unit Cost of Thermal Power Generation" is assumed to the economic benefit.

"Incremental Hydro Power Generation" is calculated by JICA Project Team 2.

"Unit Alternative Electricity Cost (Thermal Power Generation)" is estimated at IDR 2,770/kwh including fuel and other necessary cost referring the PLN statistics 2013.

"Incremental Electricity by Hydro Power Plant" is shown in Table L1.2.11.

Table L1.2.11 Unit Price and Incremental Electric Power by the Project

Scenario	Incremental Amount of Hydro Power Generation	Unit Cost of Electricity by Alternative Source
Low	-27,760Mwh	IDR 2,770 kwh
Medium	-81 Mwh	
High	-20,210Mwh	

Source: JICA Project Team 2

The result of benefit calculation in each case is shown in L1-3 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

(3) Total Economic Benefit

The above economic benefit of this project is calculated as follows.

Table L1.2.12 Economic Benefit of Water Supply Project for the Entire Period of the Project

unit: billion IDR

Scenario	Incremental Water Usage for Irrigation	Incremental Water Usage through PDAM	Incremental Power Generation of Hydropower	Total Economic Benefit
Low	24,551.4	94,197.2	-3,844.8	114,903.7
Medium	24,671.8	14,088.1	-11.2	38,748.8
High	48,227.6	0.0	-2,799.0	45,428.6

Source: JICA Project Team 2

L1.2.5 Results of Economic Analysis

Results of the economic evaluation are summarized in Table L1.2.13 and the detail calculation is presented in L1-3 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

Findings of economic evaluation is summarized as follows:

- The estimated EIRR at 13.8% surpasses the general criteria provided by donors, which is around 9-12%, for the proposed measures of low scenario. The proposed measure is economically feasible.
- In the other scenarios, the proposed measures are not economically feasible, therefore it is recommended that the plans should be reviewed and/or updated as needed.
- This analysis is done based on rough assumptions as it is difficult to forecast the

future climate change. Therefore, these measures should be updated periodically considering the newest climate data and other social situations.

Table L1.2.13 Summary of Economic Evaluation

Scenario	EIRR (%)	NPV (billion IDR)	B/C
Low	13.8%	4,169	1.6
Medium	3.2%	-6,309	0.3
High	3.5%	-6,788	0.3

Source: JICA Project Team 2

L1.2.6 Possible Fund Source of the Project

Fund sources of the most proposed measures have not been decided.

In the Brantas River Basin, some of new dams, Tugu Dam, Semantok Dam, and Bagong Dam are under construction financed by Anggaran Pendapatan dan Belanja Negara (APBN), State Budget of Indonesia.

In case of dam construction or rehabilitation project where large fund and high technical knowledge is needed, donor loans would be an appropriate fund source as well as the APBN in the future.

PART 2 MUSI RIVER BASIN

CHAPTER L2 ECONOMIC ANALYSIS AND PROJECT EVALUATION（MUSI RIVER BASIN）

L2.1 Estimation of Flood Damage

L2.1.1 General

As there is no manual or guideline for damage calculation of flood protection sector in Indonesia, the damage analysis is conducted based on the "Manual of Economical Investigation of Flood Disaster" developed by the Ministry of Land, Infrastructure and Transportation and Tourism (MILT), in Japan.

Based on this manual, flood damages are broadly divided into categories of direct damages and indirect damages. Direct damages are physical damage on assets and crops caused by flood, while indirect damages are other economic losses such as suspension of economic activities, mental damage by flood, etc. Categorization of damage items by the manual and the quantified damages in this study are shown in Table L2.1.1.

Table L2.1.1 Major Direct and Indirect Damage

Categorization of Damage	Damage Item	Calculation in this Analysis
Direct Damage	House	Done
	Household Asset	Done
	Fixed asset for Business Use	-
	Stock asset for Business Use	-
	Fixed asset for Agricultural and Fishery Household Use	-
	Stock asset for Agricultural and Fishery Household Use	-
	Agricultural Crops	Done
	Infrastructure	Done
Indirect Damage	Operation Loss of Enterprise due to Business Suspension	Done, assumed at 10% of Direct Damage
	Income Loss of the Household due to the Expense from the Flood	
	Suspension of Transportation	
	Economic Loss by Suspension of Lifeline	
	Mental Damage by Flood	

Source: JICA Project Team 2

L2.1.2 Calculation Method of Each Damage

(1) Damage to House

Damage to house is calculated by the formula below.

"**Number of Affected House" x "Average Value of House" x "Damage Rate"**

"Number of Affected House" is estimated by the inundation analysis per river basin under each return period cases.

"Average Value of House" is assumed by the interviews to several families living in the study area and real-estate developers in the area as the statistical data of house value is not available. Considering the social condition of the study area, the average houses is made of Batu Bata (red brick) or Batako (gray brick) and the floor area is 36m^2. Based on the interviews, the values of newly constructed houses are assumed to be at approximately 108,500,000 IDR in

the area. Generally, the value of houses decreases as time flows after the construction. The average residual value is assumed at 40% of the construction price as shown in Table L2.1.2.

Table L2.1.2 Values of House by the Interview of Inhabitants and Developers

	Price/Value
Average Construction Price	IDR 108,500,000
Average Value of House	IDR 43,400,000
Area	Indralaya City in South Sumatra

Source: JICA Project Team 2

The "damage rate" is quoted from the Japanese manual. The damage rates shown in Table L2.1.3 are used in the damage calculation in response to the result of the inundation analysis.

Table L2.1.3 Damage Rate for Residential Building by Inundation Depth

Inundation Depth	Gradient	< 0.5 m	0.5 – 0.99 m	1.0 – 1.99 m	2.0 – 2.99 m	3.0 m <
Damage Rate of Residential Building	<1/1000*1	0.092	0.119	0.266	0.580	0.834
	1/1000~1/500	0.126	0.176	0.343	0.647	0.870
	1/500 <	0.144	0.205	0.382	0.681	0.888

*1 Considering the gradient of the area, the damage rates of <1/1000 are applicable for this analysis.

Source: Manual of Economical Investigation of Flood Disaster, MILT, Japan, 2005 April

(2) Damage to Household Asset

Damage to household assets of electric appliances such as TV, refrigerator, radio and other furniture are assumed at 10% of the damage to house.

"Damage to Houses" x 10%

(3) Damage to Agricultural Crop

Damage to agricultural crops is calculated by the following formula.

" Affected Area of Agricultural Field (Hectare)" x "Crop Yield per Hectare" x "Economic Value of Paddy per Hectare" x "Damage Rate"

"Affected Area of Agricultural Field" is estimated by the inundation analysis under each return period cases. Only the paddy is assumed to be damaged by flood in the project area as the food occurs in rainy season when paddy is cultivated.

"Crop Yield per Hectare" is 4.72t/ha calculated by JICA Project Team 2 on the basis of "Sumatera Selatan Dalam Angkah 2017".

"Economic Value of Paddy" is estimated by assuming the rice made in Thailand is imported and transported to the project area. The price of the rice is quoted by the price forecast in 2030 made by the World Bank (Commodity Market Outlook, April 2019, World Bank). As a result, IDR3,182/kg is used as an economic farm gate price of paddy as estimated in Table L2.1.4.

Table L2.1.4 Economic Price of Paddy

		Import Parity		
		Operation	US$/ton	IDR/kg
1.	Price forecast of rice, Bangkok, Thailand, f.o.b.		363.0	
2.	Quality adjustment 95 (10% broken)		344.9	
3.	Insurance, freight, etc.		30.0	
4.	Forecast 2019 c.i.f. price of rice, Jakarta		374.9	
				5,334
5.	Port handling, storage and losses	5% +		267
6.	Transportation (port to wholesaler)	+		209
7.	Ex-wholesaler price			5,810
8.	Marketing margin	10% -		581
9.	Local transportation (village to wholesaler)	-		200
10.	Value of milled Rice			5,029
11.	Conversion of paddy	65%		3,269
12.	Milling cost	-		68
13.	Revenue of rice bran	+		150
14.	Transportation and stabilization of rice bran	-		68
15.	Local transportation (farm to village)	-		100
16.	Economic farm gate price			3,182

*1 Exchange rate*1USD=14,231IDR(Apr.2019)

Source: Calculated by JICA Project Team 2 based on the price of Commodity Market Outlook, April 2019, World Bank

Damage rates shown in Table L2.1.5 are used in the damage calculation in response to the result of the inundation analysis.

Table L2.1.5 Damage Rate for Agricultural Crops by Inundation Depth

Duration of Inundation (Day)*1	Depth of Inundation (m)	1 to 2	3 to 4	5 to 6	More than 7
Damage Rate of Agricultural Crops	<0.5	0.21	0.30	0.36	0.50
	0.5~0.99	0.24	0.44	0.50	0.71
	1<	0.37	0.54	0.64	0.74

*1: Considering the duration of inundation in the area, the damage rates of More than 7 days are applicable for this analysis.

Source: Manual of Economical Investigation of Flood Disaster, MLIT, Japan, 2005 April

(4) Damage of Infrastructure

It is difficult to estimate the damage of infrastructure in Indonesia, the methodology adopted in the Japanese manual is used for this analysis.

"Direct Damage of House and Household Asset" x 131.1%

The category of infrastructure affected by the flood is assumed as road, bridge and agricultural facility. Referring to the Japanese manual, the damage of those facilities was 131.1% of direct damage of houses and household asset as shown in Table L2.1.6 therefore the 131.1% is added as damage of infrastructure.

Table L2.1.6 Ratio of Infrastructure Damage against General Asset Damage

Facility	Road	Bridge	Agricultural Facility	Sum
Damage Ratio	61.6%	3.7%	65.8%	131.1%

Source: The Manual of Economical Investigation of Flood Disaster, MLIT, Japan, 2005 April

(5) Indirect Damage

"Direct Damage" x 10%

In addition to the direct damage, indirect damage which corresponds to economic loss of stop

of businesses and house works, suspension of transportation and lifeline services, etc. are calculated. The indirect damages are assumed at 10% of direct damage based on the interviews and other project reports.

L2.1.3 Simplified Estimate of Flood Damage Using Japanese Manual

Simplified estimate of flood damage is conducted as a reference in L2-2 Simplified Flood Damage Estimation in Data Table for Supporting Report L. The result of inundation analysis as shown in L2-1 Result of Inundation Analysis in Data Table for Supporting Report L and Japanese manual are used for this calculation. However, to conduct more accurate estimation using more suitable damage rate and using inundation depth in Indonesia through the data collection and past flood analysis, is necessary.

L2.2 Economic Analysis of Water Supply Project

Economic analysis as regard to the Water Supply Project is conducted. The main objective of the analysis here is to examine the economic feasibility of each structural measures in three climate scenarios and four river basins. Structural measures in this project are construction of dams, construction of water facilities, rehabilitation of irrigation facilities, and those of O&M works as described in L2-6 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L as direct cost and operation and maintenance cost.

Analyses conducted in this report are shown in Table L2.2.1 Structural measures with project are different in each river basin but common in each climate scenario.

Table L2.2.1 List of Future Climate Scenario and Structural Measures in the Economic Analysis

Scenario	River Basin	With Project	Without Project
Low	Komering	Structural Measure A	No Structural Measure
	Lematang	Structural Measure B	
	Kelingi	Structural Measure C	
	Lakitan	Structural Measure D	
	Total	Structural Measure A～D	
Medium	Komering	Structural Measure A	No Structural Measure
	Lematang	Structural Measure B	
	Kelingi	Structural Measure C	
	Lakitan	Structural Measure D	
	Total	Structural Measure A～D	
High	Komering	Structural Measure A	No Structural Measure
	Lematang	Structural Measure B	
	Kelingi	Structural Measure C	
	Lakitan	Structural Measure D	
	Total	Structural Measure A～D	

Source: JICA Project Team 2

L2.2.1 General

Economic evaluation aims at measuring the economic impact of the project from viewpoint of national economy. 15 economic analyses are conducted for this Water Supply Project as shown in Table L2.2.1.

The direct cost and benefit of this project is as Table L2.2.2 and details are explained in this chapter.

Table L2.2.2 Direct Cost and Benefit of this Project

Direct Cost	Benefit
• Construction of Dam Reservoir • Modification of RRF Operation • Development of DMI Water Facility • Development of Irrigation Facility	• Incremental Water Usage for Irrigation • Incremental Water Usage for Household and Factory through PDAM • Incremental Power Generation of Hydropower

Source: JICA Project Team 2

L2.2.2 Conditions of the Analysis

- All prices and costs are expressed in Indonesia Rupiah (IDR).
- Benefits and costs are evaluated from the commencement of the project until 50 years after completion of the construction, which is commonly applied to water supply project.
- The damaged agricultural crops are assumed to be paddy in the rainy season and dry season, and maize in dry season.
- Social discount rate is at 10%, which is commonly used in Indonesia.
- Conversion factor at 0.9 is applied to convert into economic cost

L2.2.3 Economic Cost of the Project

The financial cost component consists of i) Direct Construction Cost, ii) Compensation Cost, iii) Administration Cost, vi) Engineering Service Cost,v) Physical Contingency, vi) Operation and Maintenance Cost, and vii) Taxes.

Whole financial project cost is assumed to be local currency portion, and the standard conversion factor at 0.9 is applied to convert into economic cost.

The estimated economic cost is shown in Table L2.2.3. Each cost of structural measures is commonly used in all scenarios.

Table L2.2.3 Economic Total Cost for the Entire Period of the Project

(Unit: billion IDR)

	Direct Cost	Compensation, Administration, Engineering Service, Physical Contingency	O&M Cost	Total
Structural Measure A (Komering)	12,665.7	7,808.4	15,523.7	35,997.8
Structural Measure B (Lematang)	30,311.7	18,687.2	18,732.2	67,731.1
Structural Measure C (Kelingi)	1,225.1	755.3	4,119.7	6,100.1
Structural Measure D (Lakitan)	1,300.4	801.7	2,839.3	4,941.4
All Structural Measure (Total)	45,502.9	28,052.6	41,214.9	114,770.4

Source: JICA Project Team 2

Disbursement of the economic project cost is shown in L2-6 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

L2.2.4 Definition and Methodology for Calculation of Economic Benefit

(1) Definition of Economic Benefits

The benefit to be obtained by implementing the water supply project is defined as the reduction of economic damages resulting from drought. Reduction of drought damage under each

climate scenario is estimated by comparing "With Case" and "Without Case" of the water supply project. The difference of damage between "With Case" and "Without Case" is the benefit of this project.

(2) Calculation of Economic Benefit

The following tables are the calculation results of economic benefit under this project.

Under with case scenario, more water is supplied than the Without case by reducing the probability of drought. The increased water amount enables to make the following three benefits.

a) Incremental Water Usage for Irrigation
b) Incremental Water Usage for Households and Factory through PDAMs
c) Incremental Power Generation of Hydropower

Calculation methods of each item are explained below.

a) Incremental Water Usage for Irrigation

Under with case, part of damage caused by draught is avoided by the structural measures. The economic benefit is calculated by the following formula.

"Incremental Area of Agricultural Field" x "Crop Yield per Hectare" x "Economic Value of Paddy per Hectare"

The drought is assumed to occur both in rainy season and dry season. In rainy season, only the paddy is cultivated; in the first stage of dry season, paddy is cultivated; in the second stage of dry season, maize is cultivated. "Incremental Area of Agricultural Field (Hectare)" (difference with and without case scenario) for a year is summarized in Table L2.2.4 and is calculated in L2-3 Incremental Area of Agricultural Field (Water Supply Project) in Data Table for Supporting Report L. These are calculated by JICA Project Team 2 on the basis of "Sumatera Selatan Dalam Angkah 2017".

Table L2.2.4 Incremental Area of Agricultural Field per Year

unit (ha)

Scenario	River Basin	Wet Season (Paddy)	Dry Season 1 (Paddy)	Dry Season 2 (Maize)
Low	Komering	0～1,613	0～23,632	0～11,088
	Lematang	0～7,227	0～13,890	0～7,606
	Kelingi	0～128	0	0
	Lakitan	0～223	0～3,000	0～1,500
	Total	0～9,178	0～39,979	0～19,330
Medium	Komering	0～4,731	0～24,031	0～11,756
	Lematang	0～7,852	0～13,657	7,606
	Kelingi	0～302	0～302	0～25
	Lakitan	0～485	6～3,089	0～1,500
	Total	0～13,369	0～41,079	0～20,887
High	Komering	0～7,313	0～26,397	0～11,063
	Lematang	0～13,673	0～14,561	0～7,775
	Kelingi	0～152	0～50	0
	Lakitan	0～300	0～3,000	0～1,500
	Total	0～20,326	0～43,959	0～19,500

Source: JICA Project Team 2

Table L2.2.5 Crop Yield per Hectare of Paddy and Maize

unit (t/ha)

	Wet Season (Paddy)	Dry Season 1 (Paddy)	Dry Season 2 (Maize)
Crop Yield per Hectare	4.72	5.22	6.26

Source: JICA Project Team 2

The economic prices of paddy and maize are estimated by assuming those are imported from Thailand and United States. The latest price forecast data in 2030 of World Bank (Commodity Market Outlook, April 2019, World Bank) is used for the original price of crops.

The economic price of Paddy is estimated at IDR3,182/kg as shown in Table L2.1.4 and that of maize becomes IDR 2,752/kg as shown in Table L2.2.6.

The result of benefit calculation in each case is shown in L2-6 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

Table L2.2.6 Calculation of Economic Price of Maize

		Import Parity		
		Operation	US$/ton	IDR/kg
1.	Price forecast of maize, Gulf Ports, USA, f.o.b.		173.0	
2.	Insurance, freight, etc.		40.0	
3.	Forecast 2019 c.i.f. price of maize, Jakarta		213.0	
				3,031
4.	Port handling, storage and losses	5% +		152
5.	Transportation (port to wholesaler)	+		209
6.	Ex-wholesaler price			3,392
7.	Marketing margin	10% -		339
8.	Local transportation (village to wholesaler)	-		200
9.	Local transportation (farm to village)	-		100
10.	Economic farm gate price			2,752

*1:Exchange rate*1USD=14,231IDR(Apr.2019)

Source: Calculated by JICA Project Team 2 on the basis of the information of Commodity Market Outlook, April 2019, World Bank

b) Incremental Water Usage for Households and Factory through PDAM

"Unit Economic Value of Water" x "Incremental Water Volume through PDAM"

The difference of possible water usage between With and Without case scenario is the water use benefit.

"Unit Economic Value of Water" is basically estimated by quantifying the willingness to pay of users which is estimated based on interview survey. However, there is no available data of willingness to pay in the study area to be referred, the average water tariff of PDAMs in the area is used alternatively as the economic unit value of water use.

The average tariff rates of all category users in 2018 are calculated from the answers from six PDAMs as shown in Table L2.2.7.

Table L2.2.7 Average Tariff of PDAM

unit (IDR)

	All category
Average Tariff of PDAM	4,587

Source: Questionnaire to PDAMs (Tirta Kota Lubuk Linggau, Musi Banyuasin, Kab.Banyuasin ,Kab.Ogan Komering Ulu Selatan, Kab.Ogan Komering Ulu Timur, Kab.Ogan Komering Ulu,)

" Incremental Water Volume through PDAM" by this project is calculated by each river basin as shown in L2-4 Incremental Water Volume through PDAM (Water Supply Project) in Data Table for Supporting Report L and summarized in Table L2.2.8. The result of benefit calculation in each case is shown in L2-6 Economic Analysis (Water Supply Project) in Data Table for Supporting Report L.

Table L2.2.8 Incremental Water Volume

unit (m^3/day)

Scenario	River Basin	Incremental Water Volume
Low, Medium, High	Komering	4,259～171,395
	Lematang	3,313～146,698
	Kelingi	1,379～48,045
	Lakitan	891～29,926
	Total	9,842～396,064

Source: JICA Project Team 2

c) Benefit of Incremental Hydro Power Generation

"Alternative Thermal Power Generation Cost" x "Incremental Electricity Generated by Hydropower Plant"

Under without case scenario, the hydro power generation is reduced by the occurrence of drought. However, assuming the same amount of electricity is provided considering social demand. In case the electricity is produced by thermal power generation, the cost of hydropower become the benefit. Referring the PLN statistics 2015, IDR 3,090/kwh including fuel and O&M cost is used.

Incremental electric power by hydropower plant for a year is summarized in Table L2.2.9 and shown in L2-5 Incremental Electricity Generated by Hydropower Plant (Water Supply Project) in Data Table for Supporting Report L. As Hydro Power Generation are supposed to be constructed only in Komering river basin, this benefit will be calculated only for this basin.

The result of benefit calculation in each case is shown in Economic Analysis in the Data Table for L2-6 Economic Analysis (Water Supply Project) in Supporting Report L.

Table L2.2.9 Unit Price and Incremental Electric Power per Year

Scenario	River Basin	Unit Price of Electricity by Alternative Source	Incremental Electric Power by Hydropower Plant
Low Scenario	Komering	IDR 3,090/kwh	0～600Mwh
Medium Scenario			0～495Mwh
High Scenario			0～448Mwh

Source: JICA Project Team 2

(3) Total Economic Benefit of This Project

Through the calculation with the above formula and Figures, the economic benefit of this project is calculated as follows.

Table L2.2.10 Total Economic Benefit for the Entire Period of the Project

unit (billion IDR)

Scenario	River Basin	Water Usage for Irrigation	Water Usage for Households and Factory	Hydro Power Generation	Total
Low	Komering	46,135.2	18,716.6	142,976.3	207,828.1
	Lematang	34,516.6	15,954.5	-	50,471.1
	Kelingi	125.2	5,291.6	-	5,416.8
	Lakitan	5,136.6	3,312.6	-	8,449.2
	Total	85,913.7	43,275.2	142,976.3	272,165.2
Medium	Komering	53,129.5	18,716.6	117,984.3	189,830.4
	Lematang	34,515.5	15,954.5	-	50,470.0
	Kelingi	649.4	5,291.6	-	5,941.0
	Lakitan	5,489.2	3,312.6	-	8,801.8
	Total	93,783.7	43,275.2	117,984.3	255,043.2
High	Komering	55,565.4	18,716.6	106,710.4	180,992.5
	Lematang	42,398.2	15,954.5	-	58,352.6
	Kelingi	202.9	5,291.6	-	5,494.5
	Lakitan	5,211.5	3,312.6	-	8,524.1
	Total	103,378.0	43,275.2	106,710.4	253,363.6

Source: JICA Project Team 2

L2.2.5 Results of Economic Analysis

Table L2.2.11 shows the result of economic analysis in all scenarios.

Table L2.2.11 Result of Economic Analysis

Scenario	River Basin	EIRR (%)	NPV (billion IDR)	B/C
Low	Komering	13.6%	4,870	1.3
	Lematang	N/A	-5,394	0.4
	Kelingi	N/A	-811	0.3
	Lakitan	3.4%	-531	0.5
	Total	8.6%	-1,866	0.9
Medium	Komering	12.3%	3,154	1.2
	Lematang	N/A	-5,468	0.4
	Kelingi	N/A	-784	0.3
	Lakitan	3.7%	-513	0.5
	Total	7.4%	-3,611	0.9
High	Komering	11.5%	2,110	1.1
	Lematang	N/A	-4,826	0.5
	Kelingi	N/A	-807	0.3
	Lakitan	3.5%	-528	0.5
	Total	7.1%	-4,050	0.8

Source: JICA Project Team 2

Calculating from the revenue and cost estimates, EIRR of the Project of all river basins in low scenario becomes at 8.61%, that of Medium scenario becomes at 7.38% and that of high scenario becomes at 7.14%. Cash flow in all river basins of Medium scenario is shown in Figure L2.2.1. Detail economic analysis of each case is shown in L2-6 Economic Analysis (Water Supply Project).

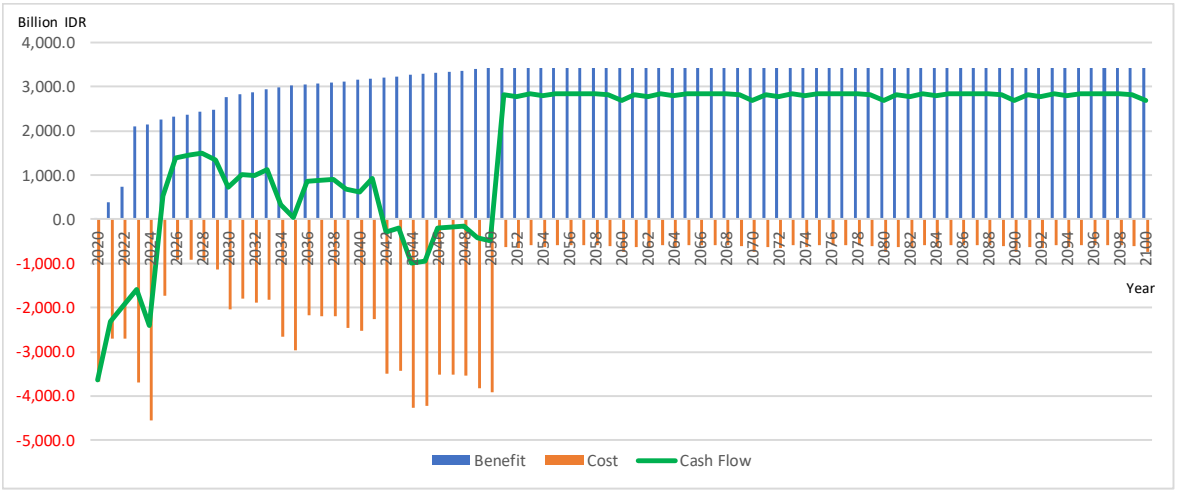

Figure L2.2.1 Result of Economic Analysis in Medium Case Scenario of All River Basins

Source: JICA Project Team 2

L2.2.6 Possible Fund Source of the Project

Most of fund sources of the measures proposed in this project have not been decided except the dam construction of the Tiga Dihaji Dam and the Komering Irrigation Project Phase III. The construction of the Tiga Dihaji Dam was commenced at the end of 2018, financed by Anggaran Pendapatan dan Belanja Negara (APBN), State Budget of Indonesia. The Komering Irrigation Project Phase III will be financed by JICA loan.

The most probable fund source of the other measures would be APBN though donor fund or other fund sources are also possible. In order to secure the APBN, which is most probable case for each measure, necessary procedures should be followed.

From a budgetary perspective, according to the information from BBWS-S8, the budget in 2019 (Approximately IDR 11 trillion) is 2.7 times as much as in 2015 (Approximately IDR 4 trillion), which shows the trend of high growth rate of the budget.

In order to consider whether the project cost (approximately IDR 90 trillion) as shown in Table10.5.2 in Chapter 10 in Main Report, is affordable or not for BBWS-S8, simple estimation is conducted using the above budget amount in 2019, and the GDP growth rate of Indonesia from 2017 to 2018 (5.17%) instead of the above high growth rate, to make the estimation conservative. The total estimated budget from 2020 to 2050 become at approximately IDR84 trillion which is a little lower than the amount of total budget of this project. Considering this figure, the said trend of budget increase, and the fact that priority project will be selected from other projects by national policy, the project cost would not be unrealistic.

Data Table

*All of sources of the tables in Data Table for Supporting Report L are "JICA Project Team 2".

BRANTAS RIVER BASIN

L1-1 Flood Damage Estimation

Low Scenario【Widas】

Return Period	Probability	Flood Damage			Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
2 years	0.50	407	0	407	204	0.49	100	100
5 years	0.20	5,495	0	5,495	2,951	0.30	885	985
10 years	0.10	18,073	0	18,073	11,784	0.10	1,178	2,163
22 years	0.05	23,162	0	23,162	20,618	0.06	1,134	3,297
30 years	0.03	26,557	0	26,557	24,860	0.01	298	3,596
50 years	0.02	51,545	51,545	0	13,279	0.01	173	3,768
100 years	0.01	65,132	65,132	0	0	0.01	0	3,768
Expected Annual Average Damage Reduction								3,768

Low Scenario【Ngotok】

Return Period	Probability	Flood Damage			Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
2 years	0.50	12,317	0	12,317	6,159	0.49	3,018	3,018
5 years	0.20	36,505	0	36,505	24,411	0.30	7,323	10,341
10 years	0.10	49,947	0	49,947	43,226	0.10	4,323	14,664
17 years	0.06	81,469	0	81,469	65,708	0.04	2,694	17,358
30 years	0.03	198,747	198,747	0	40,735	0.03	1,059	18,417
50 years	0.02	227,361	227,361	0	0	0.01	0	18,417
100 years	0.01	258,419	258,419	0	0	0.01	0	18,417
Expected Annual Average Damage Reduction								18,417

Low Scenario【Sadar】

Return Period	Probability	Flood Damage			Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
2 years	0.50	13,595	0	13,595	6,798	0.49	3,331	3,331
5 years	0.20	16,371	0	16,371	14,983	0.30	4,495	7,826
10 years	0.10	17,519	0	17,519	16,945	0.10	1,695	9,520
18 years	0.06	18,923	0	18,923	18,221	0.04	802	10,322
30 years	0.03	20,985	20,985	0	9,462	0.02	218	10,540
50 years	0.02	22,447	22,447	0	0	0.01	0	10,540
100 years	0.01	23,230	23,230	0	0	0.01	0	10,540
Expected Annual Average Damage Reduction								10,540

Low Scenario【Tawin】

Return Period	Probability	Flood Damage			Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
2 years	0.50	4,913	0	4,913	2,457	0.49	1,204	1,204
5 years	0.20	4,913	0	4,913	4,913	0.30	1,474	2,678
10 years	0.10	4,913	0	4,913	4,913	0.10	491	3,169
18 years	0.06	5,412	0	5,412	5,163	0.04	227	3,396
30 years	0.03	6,098	0	6,098	5,755	0.02	132	3,529
50 years	0.02	6,127	6,127	0	3,049	0.01	40	3,568
100 years	0.01	6,158	6,158	0	0	0.01	0	3,568
Expected Annual Average Damage Reduction								3,568

Medium Scenario【Widas】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					631	0.49	309	309
2 years	0.50	1,262	0	1,262				
					6,856	0.30	2,057	2,366
5 years	0.20	12,449	0	12,449				
					18,205	0.10	1,821	4,186
10 years	0.10	23,960	0	23,960				
					27,477	0.04	1,127	5,313
17 years	0.06	30,993	0	30,993				
					15,497	0.03	403	5,716
30 years	0.03	44,021	44,021	0				
					0	0.01	0	5,716
50 years	0.02	76,517	76,517	0				
					0	0.01	0	5,716
100 years	0.01	111,946	111,946	0				
Expected Annual Average Damage Reduction								5,716

Medium Scenario【Ngotok】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					6,137	0.49	3,007	3,007
2 years	0.50	12,274	0	12,274				
					24,390	0.30	7,317	10,324
5 years	0.20	36,505	0	36,505				
					48,330	0.10	4,833	15,157
10 years	0.10	60,154	0	60,154				
					138,525	0.07	9,281	24,438
30 years	0.03	216,895	0	216,895				
					253,477	0.01	3,295	27,733
50 years	0.02	290,058	0	290,058				
					145,029	0.01	1,450	29,184
100 years	0.01	410,961	410,961	0				
Expected Annual Average Damage Reduction								29,184

Medium Scenario【Sadar】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.990	0	0	0				
					6,798	0.49	3,331	3,331
2 years	0.500	13,595	0	13,595				
					14,983	0.30	4,495	7,826
5 years	0.200	16,371	0	16,371				
					16,945	0.10	1,695	9,520
10 years	0.100	17,519	0	17,519				
					18,226	0.04	674	10,195
16 years	0.063	18,933	0	18,933				
					9,467	0.03	284	10,479
30 years	0.033	22,331	22,331	0				
					0	0.01	0	10,479
50 years	0.020	24,401	24,401	0				
					0	0.01	0	10,479
100 years	0.010	26,919	26,919	0				
Expected Annual Average Damage Reduction								10,479

Medium Scenario【Tawin】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					2,457	0.49	1,204	1,204
2 years	0.5	4,913	0	4,913				
					4,913	0.30	1,474	2,678
5 years	0.2	4,913	0	4,913				
					4,913	0.10	491	3,169
10 years	0.1	4,913	0	4,913				
					5,498	0.04	242	3,411
18 years	0.056	6,083	0	6,083				
					6,113	0.02	141	3,551
30 years	0.033	6,142	0	6,142				
					3,071	0.01	40	3,591
50 years	0.02	6,214	6,214	0				
					0	0.01	0	3,591
100 years	0.01	8,834	8,834	0				
Expected Annual Average Damage Reduction								3,591

High Scenario【Widas】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					2,388	0.49	1,170	1,170
2 years	0.50	4,776	0	4,776				
					10,678	0.30	3,203	4,374
5 years	0.20	16,580	0	16,580				
					25,910	0.10	2,591	6,965
10 years	0.10	35,239	0	35,239				
					17,620	0.07	1,181	8,145
30 years	0.03	91,304	91,304	0				
					0	0.01	0	8,145
50 years	0.02	137,570	137,570	0				
					0	0.01	0	8,145
100 years	0.01	159,019	159,019	0				
Expected Annual Average Damage Reduction								8,145

High Scenario 【Ngotok】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					11,172	0.49	5,474	5,474
2 years	0.5	22,343	0	22,343				
					36,759	0.30	11,028	16,502
5 years	0.2	51,174	0	51,174				
					115,409	0.10	11,541	28,043
10 years	0.1	179,644	0	179,644				
					266,202	0.07	17,836	45,878
30 years	0.033	352,759	0	352,759				
					421,912	0.01	5,485	51,363
50 years	0.02	491,064	0	491,064				
					245,532	0.01	2,455	53,818
100 years	0.01	653,074	653,074	0				
Expected Annual Average Damage Reduction								53,818

High Scenario【Sadar】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					6,798	0.49	3,331	3,331
2 years	0.5	13,595	0	13,595				
					14,983	0.30	4,495	7,826
5 years	0.2	16,371	0	16,371				
					16,945	0.10	1,695	9,520
10 years	0.1	17,519	0	17,519				
					18,221	0.04	802	10,322
18 years	0.056	18,923	0	18,923				
					19,954	0.02	459	10,781
30 years	0.033	20,985	0	20,985				
					21,716	0.01	282	11,063
50 years	0.02	22,447	0	22,447				
					11,224	0.01	112	11,175
100 years	0.01	23,230	23,230	0				
Expected Annual Average Damage Reduction								11,175

High Scenario【Tawin】

Return Period	Probability	Flood Damage			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction	Accumulated Damage
		Without Project (a)	With Project (b)	Avoided Damage by Project (a) – (b)				
1 year	0.99	0	0	0				
					2,457	0.49	1,204	1,204
2 years	0.50	4,913	0	4,913				
					4,913	0.30	1,474	2,678
5 years	0.20	4,913	0	4,913				
					4,913	0.10	491	3,169
10 years	0.10	4,913	0	4,913				
					2,457	0.04	108	3,277
18 years	0.06	6,444	6,444	0				
					0	0.02	0	3,277
30 years	0.03	8,788	8,788	0				
					0	0.01	0	3,277
50 years	0.02	10,276	10,276	0				
					0	0.01	0	3,277
100 years	0.01	17,096	17,096	0				
Expected Annual Average Damage Reduction								3,277

L1-2 Economic Analysis (Flood Control Project)

Low Scenario 【Widas】																																		
Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067		
Heightening of Dike/ Dike Construction	84.9	49.8	IDR	0.0	0.0	0.0	0.4	4.9	22.1	57.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
O&M	21.2	2.4	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		
Total Cost	106.1	52.2	IDR	0.0	0.0	0.0	0.4	4.9	22.1	57.1	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		
Reduction of Flood Damage	188.4	21.1	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8		
Total Economic Benefit	188.4	21.1	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8		
Cash Flow	TOTAL	NPV	(Billion)																															
	82.3	-31.1	IDR	0.0	0.0	0.0	-0.4	-4.9	-22.1	-57.1	3.0	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3		
Economic Cost	TOTAL	NPV	(Billion)	2068	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095									
Heightening of Dike/ Dike Construction				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
O&M				0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4									
Total Cost	TOTAL	NPV	(Billion)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4									
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
	TOTAL	NPV	(Billion)																															
Reduction of Flood Damage				3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8									
Total Economic Benefit				3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8									
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
Cash Flow	TOTAL	NPV	(Billion)																															
				3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3									
EIRR	3.0%																																	
at Discount Rate of	10%																																	
B/C	0.4																																	
Low Scenario 【Ngotok】																																		
Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067		
Heightening of Dike/ Dike Construction	18.4	11.7	IDR	0.0	0.0	0.0	0.1	5.3	11.2	1.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
O&M	4.6	0.6	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Total Cost	23.0	12.2	IDR	0.0	0.0	0.0	0.1	5.3	11.2	1.9	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Economic Benefit	TOTAL	NPV	(Billion)																															
Reduction of Flood Damage	920.8	113.4	IDR	0.0	0.0	0.0	0.0	0.0	0.0	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4		
Total Economic Benefit	920.8	113.4	IDR	0.0	0.0	0.0	0.0	0.0	0.0	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4		
Cash Flow	TOTAL	NPV	(Billion)																															
	897.8	101.1	IDR	0.0	0.0	0.0	-0.1	-5.3	-11.2	16.6	18.2	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		
Economic Cost	TOTAL	NPV	(Billion)	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094				
Heightening of Dike/ Dike Construction			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
O&M			IDR	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Total Cost	TOTAL	NPV	IDR	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Economic Benefit	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Reduction of Flood Damage			IDR	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4				
Total Economic Benefit			IDR	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4				
Cash Flow	TOTAL	NPV	(Billion)																															
			IDR	18.3	18.4	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3				
EIRR	82.7%																																	
at Discount Rate of	10%																																	
B/C	9.3																																	

Low Scenario 【Sadar】																																			
Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/	4.1	2.2	IDR	0.0	0.0	0.0	0.0	0.2	0.1	1.3	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																
O&M	1.1	0.1	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cost	5.1	2.3	IDR	0.0	0.0	0.0	0.0	0.2	0.1	1.3	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economic Benefit	TOTAL	NPV	(Billion)																													
Reduction of Flood Damage	527.0	53.6	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Total Economic Benefit	527.0	53.6	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Cash Flow	TOTAL	NPV	(Billion)																													
	521.8	51.3	IDR	0.0	0.0	0.0	0.0	-0.2	-0.1	-1.3	-2.4	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Economic Cost	TOTAL	NPV	(Billion)	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096
Heightening of Dike/			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																
O&M			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cost			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economic Benefit	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reduction of Flood Damage			IDR	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Total Economic Benefit			IDR	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Cash Flow	TOTAL	NPV	(Billion)																													
	521.8	51.3	IDR	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
EIRR	118.4%																															
at Discount Rate of	10%																															
B/C	22.9																															
Low Scenario 【Tawin】																																
Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/	49.6	34.0	IDR	0.0	0.0	0.0	11.7	31.5	1.5	4.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																
O&M	12.4	1.7	IDR	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Cost	62.0	35.7	IDR	0.0	0.0	0.0	11.7	31.5	1.7	5.0	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Economic Benefit	TOTAL	NPV	(Billion)																													
Reduction of Flood Damage	178.4	24.2	IDR	0.0	0.0	0.0	0.0	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Economic Benefit	178.4	24.2	IDR	0.0	0.0	0.0	0.0	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Cash Flow	TOTAL	NPV	(Billion)																													
	116.4	-11.5	IDR	0.0	0.0	0.0	-11.7	-31.5	1.9	-1.4	3.1	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Cost	TOTAL	NPV	(Billion)	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093			
Heightening of Dike/			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Dike Construction																																
O&M			IDR	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
Total Cost			IDR	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2			
Economic Benefit	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Reduction of Flood Damage			IDR	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6			
Total Economic Benefit			IDR	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6			
Cash Flow	TOTAL	NPV	(Billion)																													
	116.3926	-11.5	IDR	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3			
EIRR	6.4%																															
at Discount Rate of	10%																															
B/C	0.7																															

Medium Scenario 【Widas】

Economic Cost	TOTAL	NPV	(Billion)	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**
Heightening of Dike/ Dike Construction	84.9	66.4	IDR	0.4	4.9	23.9	55.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M	21.2	3.2	IDR	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total Cost	106.1	69.6	IDR	0.4	4.9	23.9	55.3	0.7	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Economic Benefit	TOTAL	NPV	(Billion)																												
Reduction of Flood Damage	285.8	42.6	IDR	0.0	0.0	0.0	0.0	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Total Economic Benefit	285.8	42.6	IDR	0.0	0.0	0.0	0.0	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Cash Flow	TOTAL	NPV	(Billion)																												
	179.7	-27.0	IDR	-0.4	-4.9	-23.9	-55.3	5.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Economic Cost	TOTAL	NPV	(Billion)	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**	**2081**	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**	**2088**	**2089**	**2090**	**2091**	**2092**				
Heightening of Dike/ Dike Construction			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
O&M			IDR	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4				
Total Cost			IDR	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4				
Economic Benefit	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Reduction of Flood Damage			IDR	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7				
Total Economic Benefit			IDR	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7				
Cash Flow	TOTAL	NPV	(Billion)																												
				5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3				
EIRR	5.7%																														
at Discount Rate of	10%																														
B/C	0.6																														

Medium Scenario 【Ngotok】

Economic Cost	TOTAL	NPV	(Billion)	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**
Heightening of Dike/ Dike Construction	50.5	42.7	IDR	0.2	14.6	31.8	3.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M	12.6	2.1	IDR	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Cost	63.2	44.8	IDR	0.2	14.6	31.8	4.0	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Economic Benefit	TOTAL	NPV	(Billion)																												
Reduction of Flood Damage	1459.2	239.1	IDR	0.0	0.0	0.0	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Total Economic Benefit	1459.2	239.1	IDR	0.0	0.0	0.0	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2
Cash Flow	TOTAL	NPV	(Billion)																												
	1396.0	194.4	IDR	-0.2	-14.6	-31.8	25.1	28.8	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9
Economic Cost	TOTAL	NPV	(Billion)	**2068**	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**	**2081**	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**	**2088**	**2089**	**2090**	**2091**										
Heightening of Dike/ Dike Construction				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
O&M				0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3										
Total Cost	TOTAL	NPV	(Billion)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3										
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Reduction of Flood Damage	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Total Economic Benefit				29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2										
				29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2	29.2										
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Cash Flow	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
				28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9										

EIRR	50.9%
at Discount Rate of	10%
B/C	5.3

Medium Scenario 【Sadar】

Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/	4.1	2.9	IDR	0.0	0.2	0.2	1.2	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																
O&M	1.0	0.1	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cost	5.1	3.1	IDR	0.0	0.2	0.2	1.2	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economic Benefit	TOTAL	NPV	(Billion)																													
Reduction of Flood Damage	523.9	71.0	IDR	0.0	0.0	0.0	0.0	0.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Total Economic Benefit	523.9	71.0	IDR	0.0	0.0	0.0	0.0	0.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Cash Flow	TOTAL	NPV	(Billion)																													
	518.9	67.9	IDR	0.0	-0.2	-0.2	-1.2	-2.4	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5

Economic Cost	TOTAL	NPV	(Billion)	2068	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093
Heightening of Dike/				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																								
O&M				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cost	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reduction of Flood Damage				10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Total Economic Benefit				10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Cash Flow	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	NPV	(Billion)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5

EIRR	117.6%
at Discount Rate of	10%
B/C	23.0

Medium Scenario 【Tawin】

Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/	60.7	55.4	IDR	14.3	38.5	3.1	4.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																
O&M	15.2	2.7	IDR	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Cost	75.9	58.2	IDR	14.3	38.5	3.4	4.9	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Economic Benefit	TOTAL	NPV	(Billion)																													
Reduction of Flood Damage	179.6	32.4	IDR	0.0	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Economic Benefit	179.6	32.4	IDR	0.0	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Cash Flow	TOTAL	NPV	(Billion)																													
	103.7	-25.8	IDR	-14.3	-38.5	0.2	-1.3	3.1	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

Cost	TOTAL	NPV	(Billion)	2068	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090
Heightening of Dike/				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																					
O&M				0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total Cost	TOTAL	NPV	(Billion)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	TOTAL	NPV	(Billion)																		
Reduction of Flood Damage				3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Total Economic Benefit				3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Cash Flow	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	NPV	(Billion)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

EIRR	4.9%
at Discount Rate of	10%
B/C	0.6

High Scenario 【Widas】																																	
Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/	83.3	65.1	IDR	0.2	3.0	26.5	53.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																	
O&M	20.8	3.1	IDR	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Total Cost	104.1	68.2	IDR	0.2	3.0	26.5	53.0	1.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Economic Benefit	TOTAL	NPV	(Billion)																														
Reduction of Flood Damage	407.3	60.7	IDR	0.0	0.0	0.0	0.0	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Total Economic Benefit	407.3	60.7	IDR	0.0	0.0	0.0	0.0	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash Flow	TOTAL	NPV	(Billion)																														
	303.1	-7.5	IDR	-0.2	-3.0	-26.5	-53.0	7.2	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Cost	TOTAL	NPV	(Billion)	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092					
Heightening of Dike/				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
Dike Construction																																	
O&M				0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4					
Total Cost	TOTAL	NPV	(Billion)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4					
	TOTAL	NPV	(Billion)																														
Reduction of Flood Damage				8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1					
Total Economic Benefit				8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1					
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0					
Cash Flow	TOTAL	NPV	(Billion)																														
				7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7					
EIRR	8.8%																																
at Discount Rate of	10%																																
B/C	0.9																																
High Scenario 【Ngotok】																																	
Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/	117.9	99.5	IDR	0.3	31.5	78.4	6.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dike Construction																																	
O&M	29.5	4.8	IDR	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total Cost	147.4	104.3	IDR	0.3	31.5	78.4	7.5	1.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Economic Benefit	TOTAL	NPV	(Billion)																														
Reduction of Flood Damage	2690.9	441.0	IDR	0.0	0.0	0.0	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8
Total Economic Benefit	2690.9	441.0	IDR	0.0	0.0	0.0	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8
Cash Flow	TOTAL	NPV	(Billion)																														
	2543.5	336.7	IDR	-0.3	-31.5	-78.4	46.3	52.4	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2	53.2
Economic Cost	TOTAL	NPV	(Billion)	2068	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092										
Heightening of Dike/				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Dike Construction																																	
O&M				0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4										
Total Cost	TOTAL	NPV	(Billion)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4										
	TOTAL	NPV	(Billion)																														
Reduction of Flood Damage				8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1										
Total Economic Benefit				8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1										
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Cash Flow	TOTAL	NPV	(Billion)																														
				7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7										
EIRR	41.3%																																
at Discount Rate of	10%																																
B/C	4.2																																

High Scenario 【Sadar】

Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/ Dike Construction	9.5	6.9	IDR	0.0	0.3	0.8	2.8	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M	2.4	0.3	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cost	11.9	7.2	IDR	0.0	0.3	0.8	2.8	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economic Benefit	TOTAL	NPV	(Billion)																													
Reduction of Flood Damage	558.8	75.7	IDR	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Total Economic Benefit	558.8	75.7	IDR	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Cash Flow	TOTAL	NPV	(Billion)																													
	546.9	68.5	IDR	0.0	-0.3	-0.8	-2.8	-5.6	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Economic Cost	TOTAL	NPV	(Billion)	2068	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093								
Heightening of Dike/ Dike Construction				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								
O&M				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								
Total Cost	TOTAL	NPV	(Billion)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								
Reduction of Flood Damage				11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2								
Total Economic Benefit				11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2								
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								
Cash Flow	TOTAL	NPV	(Billion)																													
				11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1								
EIRR	74.4%																															
at Discount Rate of	10%																															
B/C	10.5																															

High Scenario 【Tawin】

Economic Cost	TOTAL	NPV	(Billion)	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
Heightening of Dike/ Dike Construction	41.0	37.4	IDR	9.6	25.2	3.6	2.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M	10.3	1.8	IDR	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Cost	51.3	39.3	IDR	9.6	25.2	3.8	2.6	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Economic Benefit	TOTAL	NPV	(Billion)																													
Reduction of Flood Damage	163.9	29.5	IDR	0.0	0.0	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Total Economic Benefit	163.9	29.5	IDR	0.0	0.0	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash Flow	TOTAL	NPV	(Billion)																													
	112.6	-9.7	IDR	-9.6	-25.2	-0.5	0.7	2.8	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Economic Cost	TOTAL	NPV	(Billion)	2068	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090											
Heightening of Dike/ Dike Construction				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0											
O&M				0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2											
Total Cost	TOTAL	NPV	(Billion)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2											
Reduction of Flood Damage				3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3											
Total Economic Benefit				3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3											
				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0											
Cash Flow	TOTAL	NPV	(Billion)																													
				3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1											
EIRR	7.2%																															
at Discount Rate of	10%																															
B/C	0.8																															

L1-3 Economic Analysis (Water Supply Project)

【Low Scenario】

		TOTAL	NPV	(Billion)	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072
Economic Cost																																			
	Kedungwarak Dam	174.6	100.7	IDR	0.0	0.0	0.0	0.0	0.0	57.7	95.5	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a	Babadan Dam	1,733.4	1,184.9	IDR	0.0	0.0	197.4	467.4	344.2	511.9	167.7	44.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Koni II Dam	1,707.3	1,283.8	IDR	0.0	194.5	460.3	339.0	504.2	165.1	44.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	Rehabilitation of Irrigation Canal	2,008.9	1,397.2	IDR	0.0	287.0	287.0	287.0	287.0	287.0	287.0	287.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Replacement of PDAMs' pipeline	333.2	231.7	IDR	0.0	47.6	47.6	47.6	47.6	47.6	47.6	47.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d	Recycling plant for sewage water	287.7	200.1	IDR	0.0	41.1	41.1	41.1	41.1	41.1	41.1	41.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Compensation Cost,Administration																																		
e	Cost, Engeneering Service, Physical Contingency	3,562.6	2,875.4	IDR	729.9	915.2	335.9	420.7	434.4	360.9	222.0	143.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
f	O&M	2,450.0	249.3	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
	Total Initial Cost (a~e)	9,807.7	7,273.8	IDR	729.9	1,485.4	1,369.3	1,602.8	1,658.5	1,471.3	905.0	585.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Cost(a~f)	12,257.7	7,523.1	IDR	729.9	1,485.4	1,369.3	1,602.8	1,658.5	1,471.3	905.0	585.5	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Economic Benefit		TOTAL	NPV	(Billion)																															
a	Incremental Water Usage for Irrigation	24,551.4	2,498.3	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0
b	Incremental Industrial Water Usage	94,197.2	9,585.3	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9
c	Incremental Power Generation of Hydropower	-3,844.8	-391.2	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9
	Total Economic Benefit	114,904	11,692	IDR	0	0	0	0	0	0	0	0	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298	2,298
Cash Flow		TOTAL	NPV	(Billion)																															
		102,646.0	4,169.2	IDR	-729.9	-1,485.4	-1,369.3	-1,602.8	-1,658.5	-1,471.3	-905.0	-585.5	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1
Economic Cost		TOTAL	NPV	(Billion)	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099				
a	Kedungwarak Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
	Babadan Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
	Koni II Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
b	Rehabilitation of Irrigation Canal			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
c	Replacement of PDAMs' pipeline			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
d	Recycling plant for sewage water			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
	Compensation Cost,Administration																																		
e	Cost, Engeneering Service, Physical Contingency			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
f	O&M			IDR	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0				
	Total Initial Cost (a~e)			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
	Total Cost(a~f)			IDR	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0				
Economic Benefit		TOTAL	NPV	(Billion)																															
a	Incremental Water Usage for Irrigation			IDR	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0	491.0				
b	Incremental Industrial Water Usage			IDR	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9	1,883.9				
c	Incremental Power Generation of Hydropower			IDR	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9	-76.9				
	Total Economic Benefit			IDR	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1	2,298.1				
Cash Flow		TOTAL	NPV	(Billion)																															
				IDR	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1	2,249.1				

EIRR	13.8%
at Discount Rate of	10%
B/C	1.6

【Medium Scenario】

	Economic Cost	TOTAL	NPV	(Billion)	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
	Kedungwarak Dam	174.6	68.8	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.7	95.5	21.4
	Babadan Dam	1,733.4	809.3	IDR	0.0	0.0	0.0	0.0	0.0	0.0	197.4	467.4	344.2	511.9	167.7	44.8
a	Kont II Dam	1,704.6	1,059.3	IDR	0.0	0.0	0.0	194.1	459.6	338.5	503.4	164.9	44.1	0.0	0.0	0.0
	Kuncir Dam	1,680.3	1,166.7	IDR	0.0	0.0	191.4	519.8	400.4	416.9	151.8	0.0	0.0	0.0	0.0	0.0
	Genteng Dam	1,027.8	458.4	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.3	360.9	405.6	126.0	0.0
b	Rehabilitation of Irrigaiton Canal	2,008.9	1,122.2	IDR	0.0	0.0	200.9	200.9	200.9	200.9	200.9	200.9	200.9	200.9	200.9	200.9
c	Replacement of PDAMs' pipe	333.2	186.1	IDR	0.0	0.0	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3
d	Recycling plant for sewage water	287.7	160.7	IDR	0.0	0.0	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8
e	Compensation Cost,Administration Cost, Engeneering Service, Physical Contingency	5,591.0	3,718.1	IDR	356.5	718.5	509.6	317.5	732.9	917.0	580.7	371.5	365.5	402.4	212.0	107.0
f	O&M	3,635.0	252.6	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Initial Cost (a~e)	14,541.6	8,749.7	IDR	356.5	718.5	964.0	1,294.4	1,856.0	1,935.4	1,696.2	1,402.0	1,377.7	1,640.5	864.1	436.2
	Total Cost(a～f)	18,176.6	9,002.3	IDR	356.5	718.5	964.0	1,294.4	1,856.0	1,935.4	1,696.2	1,402.0	1,377.7	1,640.5	864.1	436.2
	Economic Benefit	**TOTAL**	**NPV**	**(Billion)**												
a	Incremental Water Usage for Irrigation	24,671.8	1,714.7	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	Incremental Industrial Water Usage	14,088.1	979.1	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Incremental Power Generation of Hydropower	-11.2	-0.8	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Economic Benefit	38,748.8	2,693.1	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cash Flow	**TOTAL**	**NPV**	**(Billion)**												
	Cashflow	20,572.2	-6,309.2	IDR	-356.5	-718.5	-964.0	-1,294.4	-1,856.0	-1,935.4	-1,696.2	-1,402.0	-1,377.7	-1,640.5	-864.1	-436.2

	Economic Cost	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068
	Kedungwarak Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Babadan Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a	Kont II Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Kuncir Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Genteng Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	Rehabilitation of Irrigaiton Canal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Replacement of PDAMs' pipe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d	Recycling plant for sewage water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
e	Compensation Cost,Administration Cost, Engeneering Service, Physical Contingency	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
f	O&M	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7
	Total Initial Cost (a~e)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Cost(a～f)	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7
	Economic Benefit																			
a	Incremental Water Usage for Irrigation	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4
b	Incremental Industrial Water Usage	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8
c	Incremental Power Generation of Hydropower	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
	Total Economic Benefit	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0
	Cash Flow																			
	Cashflow	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3

	Economic Cost	TOTAL	NPV	(Billion)	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084
	Kedungwarak Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Babadan Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a	Kont II Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Kuncir Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Genteng Dam			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	Rehabilitation of Irrigaiton Canal			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Replacement of PDAMs' pipe			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d	Recycling plant for sewage water			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
e	Compensation Cost,Administration Cost, Engeneering Service, Physical Contingency			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
f	O&M			IDR	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7
	Total Initial Cost (a~e)			IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Cost(a～f)			IDR	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7
	Economic Benefit	**TOTAL**	**NPV**	**(Billion)**																
a	Incremental Water Usage for Irrigation			IDR	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4
b	Incremental Industrial Water Usage			IDR	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8
	Incremental Power Generation of Hydropower			IDR	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
	Total Economic Benefit			IDR	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0
	Cash Flow	**TOTAL**	**NPV**	**(Billion)**																
	Cashflow			IDR	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3

	Economic Cost	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
	Kedungwarak Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Babadan Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a	Kont II Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Kuncir Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Genteng Dam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b	Rehabilitation of Irrigaiton Canal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c	Replacement of PDAMs' pipe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d	Recycling plant for sewage water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
e	Compensation Cost,Administration Cost, Engeneering Service, Physical Contingency	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
f	O&M	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7
	Total Initial Cost (a~e)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Cost(a～f)	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7	72.7
	Economic Benefit															
a	Incremental Water Usage for Irrigation	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4	493.4
b	Incremental Industrial Water Usage	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8
	Incremental Power Generation of Hydropower	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
	Total Economic Benefit	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0	775.0
	Cash Flow															
	Cashflow	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3	702.3

EIRR	3.2%
at Discount Rate of	10%
B/C	0.3

【High Scenario】

		TOTAL	NPV		2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068
Economic Cost				(Billion)																															
Kedungwarak Dam		174.6	68.8	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.7	95.5	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Babadan Dam		1,733.4	809.3	IDR	0.0	0.0	0.0	0.0	0.0	0.0	197.4	467.4	344.2	511.9	167.7	44.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kont II Dam		1,704.6	1,059.3	IDR	0.0	0.0	0.0	194.1	459.6	338.5	503.4	164.9	44.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kuncir Dam		1,680.3	1,166.7	IDR	0.0	0.0	191.4	519.8	400.4	416.9	151.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a Genteng Dam		1,027.8	458.4	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.3	360.9	405.6	126.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ketandan Dam		237.6	93.6	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.5	130.0	29.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kampak Dam		490.5	282.9	IDR	0.0	0.0	0.0	0.0	162.0	268.4	60.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sutami Dam (heightning)		156.6	116.7	IDR	0.0	0.0	32.6	74.6	49.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rehabilitation of Irrigation Canal		2,008.9	1,122.2	IDR	0.0	0.0	200.9	200.9	200.9	200.9	200.9	200.9	200.9	200.9	200.9	200.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b Replacement of PDAMs' pipe		333.2	186.1	IDR	0.0	0.0	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c Recycling plant for sewage water		287.7	160.7	IDR	0.0	0.0	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compensation Cost;Administration																																		
d Cost, Engeneering Service, Physical		6,254.6	4,141.2	IDR	390.2	752.1	520.2	445.7	853.0	969.7	667.9	441.4	415.9	427.9	254.2	116.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contingency																																		
e O&M		4,022.5	279.6	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4
Total Initial Cost (a-e)		16,089.8	9,666.1	IDR	390.2	752.1	1,007.2	1,497.3	2,025.3	2,150.1	2,051.9	1,532.1	1,428.1	1,744.5	1,036.4	474.8	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4
Total Cost(a-f)		20,112.3	9,945.6	IDR	390.2	752.1	1,007.2	1,497.3	2,025.3	2,150.1	2,051.9	1,532.1	1,428.1	1,744.5	1,036.4	474.8	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4
Economic Benefit		TOTAL	NPV	(Billion)																														
a Incremental Water Usage for Irrigation		48,227.6	3,351.9	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6
b Incremental Industrial Water Usage		0.0	0.0	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c Incremental Power Generation of																																		
Hydropower		-2,799.0	-194.5	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0
Total Economic Benefit		45,428.6	3,157.4	IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6
Cash Flow		TOTAL	NPV	(Billion)																														
Cashflow		25,316.3	-6,788.3	IDR	-390.2	-752.1	-1,007.2	-1,497.3	-2,025.3	-2,150.1	-2,051.9	-1,532.1	-1,428.1	-1,744.5	-1,036.4	-474.8	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1
Economic Cost		TOTAL	NPV	(Billion)	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
Kedungwarak Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Babadan Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kont II Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kuncir Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
a Genteng Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ketandan Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kampak Dam				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sutami Dam (heightning)				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rehabilitation of Irrigation Canal				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b Replacement of PDAMs' pipe				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c Recycling plant for sewage water				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compensation Cost;Administration																																		
d Cost, Engeneering Service, Physical				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contingency																																		
e O&M				IDR	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4
Total Initial Cost (a-e)				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Cost(a-f)				IDR	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4
Economic Benefit		TOTAL	NPV	(Billion)																														
a Incremental Water Usage for Irrigation				IDR	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6	964.6
b Incremental Industrial Water Usage				IDR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c Incremental Power Generation of																																		
Hydropower				IDR	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0	-56.0
Total Economic Benefit				IDR	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6	908.6
Cash Flow		TOTAL	NPV	(Billion)																														
Cashflow				IDR	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1	828.1

EIRR	3.5%
at Discount Rate of	10%
B/C	0.3

MUSI RIVER BASIN

L2-1 Result of Inundation Analysis

【Number of Houses Affected by Flood Inundation】

Scenario	Return Period	Inundatio Depth above Floor Level					Total
		<0.5m	0.5-0.99m	1.00-1.99m	2.00-2.99m	>3.00m	
Without Climate Change	2 years	0	0	0	0	0	0
	5 years	157,441	14,169	2,603	47	0	174,259
	10 years	176,664	18,035	6,375	312	30	201,415
	20 years	183,587	31,587	11,472	939	30	227,614
	50 years	200,193	41,050	14,288	1,513	91	257,135
	100 years	205,121	48,048	16,927	1,722	113	271,931
High	2 years	173,717	14,041	1,714	73	0	189,545
	5 years	195,477	28,380	9,543	475	30	233,904
	10 years	185,403	45,731	14,111	1,520	91	246,857
	20 years	182,955	61,431	18,605	1,575	122	264,688
	50 years	198,796	64,323	19,747	2,173	139	285,178
	100 years	186,940	86,192	21,428	3,026	139	297,725
Medium	2 years	141,675	5,847	661	0	0	148,183
	5 years	178,179	19,603	3,410	195	0	201,386
	10 years	186,858	25,330	7,981	464	30	220,663
	20 years	204,832	39,927	13,897	890	80	259,626
	50 years	185,426	47,096	14,450	1,507	91	248,570
	100 years	208,767	53,398	16,754	1,506	124	280,549
Low	2 years	104,443	4,348	701	0	0	109,492
	5 years	168,021	12,483	1,670	31	0	182,205
	10 years	178,201	19,603	3,410	195	0	201,409
	20 years	186,022	27,438	7,858	464	30	221,812
	50 years	203,608	33,773	10,887	508	30	248,806
	100 years	200,347	45,262	13,975	1,185	80	260,849

【Paddy Field Affected by Flood Inundation(ha)】

Scenario	Return Period	Inundatio Depth above Floor Level			Total
		<0.5m	0.5-0.99m	1.00m<	
Without Climate Change	2 years	29,565	9,565	7,227	46,356
	5 years	30,088	10,103	7,003	47,194
	10 years	30,677	10,207	7,010	47,894
	20 years	32,324	11,121	7,031	50,476
	50 years	33,165	11,621	6,908	51,694
	100 years	34,960	11,217	7,617	53,794
High	2 years	34,359	15,700	8,784	58,843
	5 years	35,467	16,593	8,584	60,643
	10 years	36,525	17,642	8,577	62,743
	20 years	38,939	17,728	8,977	65,643
	50 years	41,652	17,793	9,499	68,943
	100 years	51,246	18,107	9,599	78,952
Medium	2 years	33,812	15,847	8,884	58,543
	5 years	33,585	16,466	8,792	58,843
	10 years	35,203	16,156	8,684	60,043
	20 years	35,930	17,537	8,477	61,943
	50 years	36,639	17,628	8,677	62,943
	100 years	37,234	17,933	8,677	63,843
Low	2 years	33,372	16,090	8,740	58,201
	5 years	34,000	15,959	8,884	58,843
	10 years	33,585	16,466	8,792	58,843
	20 years	35,090	15,870	8,684	59,643
	50 years	35,630	17,237	8,477	61,343
	100 years	35,839	17,528	8,577	61,943

L2-2 Simplified Flood Damage Estimation

【Damage to House】

Damage to Hosuse Without Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	0	0.500	0	0
2 years	0	366,515	0.300	109,954	109,954
5 years	733,030	807,045	0.100	80,705	190,659
10 years	881,060	967,190	0.050	48,360	239,019
20 years	1,053,321	1,135,499	0.030	34,065	273,083
50 years	1,217,677	1,263,845	0.010	12,638	285,722
100 years	1,310,013				
Expected Average Annual Damage					285,722

Damage to House High Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	393,875	0.500	196,938	196,938
2 years	787,750	919,011	0.300	275,703	472,641
5 years	1,050,272	1,115,604	0.100	111,560	584,201
10 years	1,180,937	1,243,769	0.050	62,188	646,390
20 years	1,306,601	1,360,129	0.030	40,804	687,194
50 years	1,413,656	1,466,902	0.010	14,669	701,863
100 years	1,520,147				
Expected Average Annual Damage					701,863

Damage to House Medium Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	301,755	0.500	150,878	150,878
2 years	603,511	730,225	0.300	219,067	369,945
5 years	856,938	919,369	0.100	91,937	461,882
10 years	981,800	1,095,785	0.050	54,789	516,671
20 years	1,209,769	1,200,710	0.030	36,021	552,693
50 years	1,191,651	1,268,410	0.010	12,684	565,377
100 years	1,345,170				
Expected Average Annual Damage					565,377

Damage to House Low Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	223,786	0.500	111,893	111,893
2 years	447,571	601,491	0.300	180,447	292,340
5 years	755,410	806,219	0.100	80,622	372,962
10 years	857,028	922,479	0.050	46,124	419,086
20 years	987,930	1,057,437	0.030	31,723	450,809
50 years	1,126,944	1,177,347	0.010	11,773	462,582
100 years	1,227,749				
Expected Average Annual Damage					462,582

【Damage to Irrigation】

Damage to Irrigation Without Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	202,164	0.500	101,082	101,082
2 years	404,329	407,918	0.300	122,375	223,458
5 years	411,508	414,312	0.100	41,431	264,889
10 years	417,117	428,293	0.050	21,415	286,303
20 years	439,469	444,611	0.030	13,338	299,642
50 years	449,752	458,278	0.010	4,583	304,225
100 years	466,804				
Expected Average Annual Damage					304,225

Damage to Irrigation High Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	261,534	0.500	130,767	130,767
2 years	523,067	530,873	0.300	159,262	290,029
5 years	538,679	548,206	0.100	54,821	344,849
10 years	557,732	569,477	0.050	28,474	373,323
20 years	581,222	594,656	0.030	17,840	391,163
50 years	608,090	646,346	0.010	6,463	397,626
100 years	684,601				
Expected Average Annual Damage					397,626

Damage to Irrigation Medium Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	260,820	0.500	130,410	130,410
2 years	521,639	523,576	0.300	157,073	287,482.48
5 years	525,512	529,334	0.100	52,933	340,415.89
10 years	533,156	542,094	0.050	27,105	367,520.61
20 years	551,033	555,291	0.030	16,659	384,179.34
50 years	559,550	563,410	0.010	5,634	389,813.44
100 years	567,270				
Expected Average Annual Damage					389,813

Damage to Irrigation Low Case (Million IDR)

Return Period	Flood Damage	Interval Average of Damage Reduction	Interval Provability	Annual Average Damage	Accumulated Damage
1 year	0	259,656	0.500	129,828	129,828
2 years	519,312	521,778	0.300	156,533	286,362
5 years	524,244	524,878	0.100	52,488	338,849
10 years	525,512	527,381	0.050	26,369	365,218
20 years	529,249	537,415	0.030	16,122	381,341
50 years	545,581	548,473	0.010	5,485	386,826
100 years	551,364				
Expected Average Annual Damage					386,826

Total Annual Average Damage (Million IDR)

	Damage to House	Damage to Household Asset	Damage to Agriculture	Damage to Infrastructure	Indirect Damage	Total Average Annual
Without	285,722	28,572	304,225	412,040	103,056	1,133,614
High	701,863	70,186	397,626	1,012,156	218,183	2,400,014
Medium	565,377	56,538	389,813	815,330	182,706	2,009,763
Low	462,582	46,258	386,826	667,090	156,276	1,719,032

L2-3 Incremental Area of Agricultural Field (Water Supply Project)

1. Komering

Low Case

	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
Paddy Wet (ha)																																	
With	7,452,942	90,567	89,906	89,244	89,241	89,241	92,180	92,180	92,180	92,180	92,180	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167	92,167
Without	7,335,935	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567	90,567
Difference	121,645	0	0	0	0	0	1,613	1,613	1,613	1,613	1,613	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Paddy Dry (ha)																																	
	Total	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051~2100**
With	6,732,536	60,625	68,706	76,787	80,737	84,256	84,256	84,256	84,256	84,256	84,256	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714	83,714
Without	4,910,593	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625	60,625
Difference	1,821,943	0	8,081	16,162	20,113	23,632	23,632	23,632	23,632	23,632	23,632	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089	23,089
Maize Dry (ha)																																	
	Total	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051~2100**
With	3,281,398	30,446	35,789	41,131	41,534	41,534	40,681	40,681	40,681	40,681	40,681	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670	40,670
Without	2,466,095	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446	30,446
Difference	815,303	0	5,343	10,686	11,088	11,088	10,236	10,236	10,236	10,236	10,236	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224	10,224

Medium Case

	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
Paddy Wet (ha)																																	
With	7,597,480	89,455	86,753	84,052	89,977	89,977	94,019	94,019	94,019	94,019	94,019	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186	94,186
Without	7,245,845	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455	89,455
Difference	359,739	0	0	0	522	522	4,564	4,564	4,564	4,564	4,564	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731	4,731
Paddy Dry (ha)																																	
	Total	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051~2100**
With	7,063,694	63,681	74,064	84,446	87,710	87,710	87,710	87,710	87,710	87,710	87,710	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712	87,712
Without	5,158,142	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681	63,681
Difference	1,905,552	0	10,383	20,766	24,029	24,029	24,029	24,029	24,029	24,029	24,029	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031	24,031
Maize Dry (ha)																																	
	Total	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051~2100**
With	3,430,842	30,836	36,208	41,579	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593	42,593
Without	2,497,723	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836	30,836
Difference	933,118	0	5,371	10,743	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756	11,756

High Case

	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
Paddy Wet (ha)																																	
With	6,712,935	77,117	73,329	69,541	77,651	77,651	84,430	84,430	84,430	84,430	84,430	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317	83,317
Without	6,246,467	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117	77,117
Difference	477,831	0	0	0	534	534	7,313	7,313	7,313	7,313	7,313	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200
Paddy Dry (ha)																																	
	Total	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051~2100**
With	6,935,771	60,054	68,431	76,808	81,844	81,844	86,451	86,451	86,451	86,451	86,451	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402	86,402
Without	4,864,363	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054	60,054
Difference	2,071,408	0	8,377	16,754	21,790	21,790	26,397	26,397	26,397	26,397	26,397	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348	26,348
Maize Dry (ha)																																	
	Total	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051~2100**
With	3,253,622	30,148	35,496	40,845	41,211	41,211	39,655	39,655	39,655	39,655	39,655	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372	40,372
Without	2,441,973	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148	30,148
Difference	811,649	0	5,349	10,697	11,063	11,063	9,507	9,507	9,507	9,507	9,507	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225	10,225

2. Lematang

Low Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	4,412,140	47,933	48,444	48,954	49,465	49,976	50,487	50,998	51,509	52,020	52,531	53,042	53,553	54,064	54,575	55,086	55,086	55,086	55,086	55,086	55,086	55,086	55,086	55,102	55,102	55,102	55,102	55,102	55,102	55,102	55,102	55,102	55,160
Without	3,882,535	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933	47,933
Difference	529,605	0	511	1,022	1,533	2,044	2,555	3,066	3,577	4,088	4,599	5,110	5,621	6,132	6,643	7,154	7,154	7,154	7,154	7,154	7,154	7,154	7,154	7,169	7,169	7,169	7,169	7,169	7,169	7,169	7,169	7,169	7,227
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	2,286,750	15,627	16,619	17,612	18,604	19,596	20,588	21,580	22,572	23,565	24,557	25,549	26,541	27,533	28,525	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518
Without	1,265,803	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627	15,627
Difference	1,020,947	0	992	1,984	2,977	3,969	4,961	5,953	6,945	7,937	8,930	9,922	10,914	11,906	12,898	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890	13,890
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	945,205	4,786	5,322	5,858	6,394	6,930	7,467	8,003	8,539	9,075	9,611	10,147	10,683	11,219	11,755	12,291	12,326	12,326	12,326	12,326	12,326	12,326	12,326	12,361	12,361	12,361	12,361	12,361	12,361	12,361	12,361	12,361	12,392
Without	387,695	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786
Difference	557,509	0	536	1,072	1,608	2,144	2,680	3,216	3,752	4,288	4,824	5,360	5,896	6,432	6,968	7,504	7,539	7,539	7,539	7,539	7,539	7,539	7,539	7,575	7,575	7,575	7,575	7,575	7,575	7,575	7,575	7,575	7,606

Medium Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	4,381,357	47,307	47,756	48,205	48,653	49,102	49,551	50,000	50,448	50,897	51,346	51,794	52,243	52,692	53,141	53,589	53,946	53,946	53,946	53,946	53,946	53,946	53,946	54,337	54,337	54,337	54,337	54,337	54,337	54,337	54,337	54,337	55,160
Without	3,831,880	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307	47,307
Difference	549,477	0	449	897	1,346	1,795	2,244	2,692	3,141	3,590	4,039	4,487	4,936	5,385	5,833	6,282	6,639	6,639	6,639	6,639	6,639	6,639	6,639	7,029	7,029	7,029	7,029	7,029	7,029	7,029	7,029	7,029	7,852
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	2,288,502	15,861	16,836	17,812	18,787	19,763	20,738	21,714	22,689	23,665	24,640	25,616	26,591	27,567	28,542	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518	29,518
Without	1,284,718	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861	15,861
Difference	1,003,784	0	975	1,951	2,926	3,902	4,877	5,853	6,828	7,804	8,779	9,755	10,730	11,706	12,681	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657	13,657
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	944,365	4,786	5,317	5,848	6,378	6,909	7,439	7,970	8,500	9,031	9,562	10,092	10,623	11,153	11,684	12,215	12,293	12,293	12,293	12,293	12,293	12,293	12,293	12,357	12,357	12,357	12,357	12,357	12,357	12,357	12,357	12,357	12,392
Without	387,695	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786	4,786
Difference	556,670	0	531	1,061	1,592	2,122	2,653	3,183	3,714	4,245	4,775	5,306	5,836	6,367	6,898	7,428	7,507	7,507	7,507	7,507	7,507	7,507	7,507	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,570	7,606

High Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	4,349,478	41,486	42,396	43,305	44,215	45,124	46,034	46,943	47,852	48,762	49,671	50,581	51,490	52,400	53,309	54,219	54,468	54,468	54,468	54,468	54,468	54,468	54,468	54,715	54,715	54,715	54,715	54,715	54,715	54,715	54,715	54,715	55,160
Without	3,360,385	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486	41,486
Difference	989,093	0	909	1,819	2,728	3,638	4,547	5,457	6,366	7,276	8,185	9,095	10,004	10,914	11,823	12,733	12,982	12,982	12,982	12,982	12,982	12,982	12,982	13,228	13,228	13,228	13,228	13,228	13,228	13,228	13,228	13,228	13,673
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	2,279,778	14,956	15,987	17,017	18,047	19,077	20,108	21,138	22,168	23,198	24,229	25,259	26,289	27,319	28,349	29,380	29,429	29,429	29,429	29,429	29,429	29,429	29,429	29,486	29,486	29,486	29,486	29,486	29,486	29,486	29,486	29,486	29,518
Without	1,211,468	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956	14,956
Difference	1,068,310	0	1,030	2,060	3,091	4,121	5,151	6,181	7,212	8,242	9,272	10,302	11,333	12,363	13,393	14,423	14,473	14,473	14,473	14,473	14,473	14,473	14,473	14,529	14,529	14,529	14,529	14,529	14,529	14,529	14,529	14,529	14,561
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	942,718	4,617	5,158	5,699	6,240	6,781	7,321	7,862	8,403	8,944	9,485	10,026	10,567	11,108	11,649	12,190	12,277	12,277	12,277	12,277	12,277	12,277	12,277	12,348	12,348	12,348	12,348	12,348	12,348	12,348	12,348	12,348	12,392
Without	373,962	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617	4,617
Difference	568,756	0	541	1,082	1,623	2,164	2,705	3,246	3,787	4,327	4,868	5,409	5,950	6,491	7,032	7,573	7,661	7,661	7,661	7,661	7,661	7,661	7,661	7,731	7,731	7,731	7,731	7,731	7,731	7,731	7,731	7,731	7,775

3. Kelingi

Low Case

	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
Paddy Wet (ha)																																	
With	963,344	11,790	11,794	11,798	11,803	11,807	11,811	11,815	11,819	11,823	11,827	11,832	11,836	11,840	11,844	11,848	11,852	11,856	11,861	11,865	11,869	11,873	11,877	11,881	11,885	11,890	11,894	11,898	11,902	11,906	11,910	11,914	11,918
Without	955,008	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790	11,790
Difference	8,336	0	4	8	12	17	21	25	29	33	37	41	46	50	54	58	62	66	70	74	79	83	87	91	95	99	103	108	112	116	120	124	128
Paddy Dry (ha)																																	
With	873,697	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Without	873,697	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maize Dry (ha)																																	
With	424,225	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237
Without	424,225	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237
Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Medium Case

	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
Paddy Wet (ha)																																	
With	616,730	7,372	7,381	7,391	7,401	7,411	7,420	7,430	7,440	7,450	7,459	7,469	7,479	7,489	7,498	7,508	7,518	7,528	7,537	7,547	7,557	7,566	7,576	7,586	7,596	7,605	7,615	7,625	7,635	7,644	7,654	7,664	7,674
Without	597,111	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372	7,372
Difference	19,619	0	10	19	29	39	49	58	68	78	88	97	107	117	127	136	146	156	166	175	185	195	204	214	224	234	243	253	263	273	282	292	302
Paddy Dry (ha)																																	
With	704,442	8,454	8,464	8,474	8,483	8,493	8,503	8,513	8,522	8,532	8,542	8,552	8,561	8,571	8,581	8,591	8,601	8,610	8,620	8,630	8,640	8,649	8,659	8,669	8,679	8,688	8,698	8,708	8,718	8,727	8,737	8,747	8,757
Without	684,793	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454	8,454
Difference	19,649	0	10	20	29	39	49	59	68	78	88	98	107	117	127	137	146	156	166	176	185	195	205	215	224	234	244	254	263	273	283	293	302
Maize Dry (ha)																																	
With	417,042	5,128	5,129	5,130	5,131	5,132	5,132	5,133	5,134	5,135	5,136	5,137	5,137	5,138	5,139	5,140	5,141	5,141	5,142	5,143	5,144	5,145	5,146	5,146	5,147	5,148	5,149	5,150	5,150	5,151	5,152	5,153	5,154
Without	415,397	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128	5,128
Difference	1,645	0	1	2	2	3	4	5	6	7	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20	20	21	22	23	24	24	25

High Case

	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
Paddy Wet (ha)																																	
With	978,361	11,956	11,961	11,966	11,971	11,976	11,981	11,986	11,991	11,996	12,001	12,005	12,010	12,015	12,020	12,025	12,030	12,035	12,040	12,045	12,050	12,055	12,059	12,064	12,069	12,074	12,079	12,084	12,089	12,094	12,099	12,104	12,109
Without	968,461	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956	11,956
Difference	9,900	0	5	10	15	20	25	29	34	39	44	49	54	59	64	69	74	79	84	88	93	98	103	108	113	118	123	128	133	138	142	147	152
Paddy Dry (ha)																																	
With	872,342	10,729	10,731	10,733	10,734	10,736	10,737	10,739	10,741	10,742	10,744	10,746	10,747	10,749	10,750	10,752	10,754	10,755	10,757	10,759	10,760	10,762	10,763	10,765	10,767	10,768	10,770	10,771	10,773	10,775	10,776	10,778	10,780
Without	869,080	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729	10,729
Difference	3,262	0	2	3	5	6	8	10	11	13	15	16	18	19	21	23	24	26	28	29	31	32	34	36	37	39	40	42	44	45	47	49	50
Maize Dry (ha)																																	
With	424,225	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237
Without	424,225	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237
Difference	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4. Lakitan

Low Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	1,237,589	15,100	15,107	15,114	15,121	15,128	15,136	15,143	15,150	15,157	15,165	15,172	15,179	15,186	15,193	15,201	15,208	15,215	15,222	15,229	15,237	15,244	15,251	15,258	15,265	15,273	15,280	15,287	15,294	15,301	15,309	15,316	15,323
Without	1,223,073	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100
Difference	14,515	0	7	14	22	29	36	43	50	58	65	72	79	86	94	101	108	115	122	130	137	144	151	158	166	173	180	187	194	202	209	216	223
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	881,100	8,470	8,567	8,664	8,761	8,857	8,954	9,051	9,148	9,245	9,341	9,438	9,535	9,632	9,728	9,825	9,922	10,019	10,116	10,212	10,309	10,406	10,503	10,599	10,696	10,793	10,890	10,987	11,083	11,180	11,277	11,374	11,470
Without	686,100	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470
Difference	195,000	0	97	194	290	387	484	581	677	774	871	968	1,065	1,161	1,258	1,355	1,452	1,548	1,645	1,742	1,839	1,935	2,032	2,129	2,226	2,323	2,419	2,516	2,613	2,710	2,806	2,903	3,000
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	409,155	3,848	3,896	3,944	3,993	4,041	4,090	4,138	4,186	4,235	4,283	4,331	4,380	4,428	4,477	4,525	4,573	4,622	4,670	4,719	4,767	4,815	4,864	4,912	4,960	5,009	5,057	5,106	5,154	5,202	5,251	5,299	5,348
Without	311,655	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848
Difference	97,500	0	48	97	145	194	242	290	339	387	435	484	532	581	629	677	726	774	823	871	919	968	1,016	1,065	1,113	1,161	1,210	1,258	1,306	1,355	1,403	1,452	1,500

Medium Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	1,048,937	12,561	12,577	12,592	12,608	12,624	12,639	12,655	12,670	12,686	12,702	12,717	12,733	12,749	12,764	12,780	12,795	12,811	12,827	12,842	12,858	12,874	12,889	12,905	12,921	12,936	12,952	12,967	12,983	12,999	13,014	13,030	13,046
Without	1,017,441	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561	12,561
Difference	31,496	0	16	31	47	63	78	94	109	125	141	156	172	188	203	219	234	250	266	281	297	313	328	344	360	375	391	406	422	438	453	469	485
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	848,126	7,997	8,096	8,196	8,295	8,395	8,494	8,594	8,693	8,793	8,892	8,991	9,091	9,190	9,290	9,389	9,489	9,588	9,687	9,787	9,886	9,986	10,085	10,185	10,284	10,384	10,483	10,582	10,681	10,781	10,881	10,980	11,080
Without	647,251	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991	7,991
Difference	200,874	6	106	205	305	404	503	603	702	802	901	1,001	1,100	1,200	1,299	1,398	1,498	1,597	1,697	1,796	1,896	1,995	2,094	2,194	2,293	2,393	2,492	2,592	2,691	2,791	2,890	2,989	3,089
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	409,155	3,848	3,896	3,944	3,993	4,041	4,090	4,138	4,186	4,235	4,283	4,331	4,380	4,428	4,477	4,525	4,573	4,622	4,670	4,719	4,767	4,815	4,864	4,912	4,960	5,009	5,057	5,106	5,154	5,202	5,251	5,299	5,348
Without	311,655	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848
Difference	97,500	0	48	97	145	194	242	290	339	387	435	484	532	581	629	677	726	774	823	871	919	968	1,016	1,065	1,113	1,161	1,210	1,258	1,306	1,355	1,403	1,452	1,500

High Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	1,241,541	15,087	15,097	15,106	15,116	15,126	15,135	15,145	15,155	15,164	15,174	15,184	15,193	15,203	15,213	15,222	15,232	15,242	15,251	15,261	15,271	15,280	15,290	15,300	15,310	15,319	15,329	15,339	15,348	15,358	15,368	15,377	15,387
Without	1,222,041	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087	15,087
Difference	19,500	0	10	19	29	39	48	58	68	77	87	97	106	116	126	135	145	155	165	174	184	194	203	213	223	232	242	252	261	271	281	290	300
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	881,100	8,470	8,567	8,664	8,761	8,857	8,954	9,051	9,148	9,245	9,341	9,438	9,535	9,632	9,728	9,825	9,922	10,019	10,116	10,212	10,309	10,406	10,503	10,599	10,696	10,793	10,890	10,987	11,083	11,180	11,277	11,374	11,470
Without	686,100	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470	8,470
Difference	195,000	0	97	194	290	387	484	581	677	774	871	968	1,065	1,161	1,258	1,355	1,452	1,548	1,645	1,742	1,839	1,935	2,032	2,129	2,226	2,323	2,419	2,516	2,613	2,710	2,806	2,903	3,000
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	409,155	3,848	3,896	3,944	3,993	4,041	4,090	4,138	4,186	4,235	4,283	4,331	4,380	4,428	4,477	4,525	4,573	4,622	4,670	4,719	4,767	4,815	4,864	4,912	4,960	5,009	5,057	5,106	5,154	5,202	5,251	5,299	5,348
Without	311,655	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848	3,848
Difference	97,500	0	48	97	145	194	242	290	339	387	435	484	532	581	629	677	726	774	823	871	919	968	1,016	1,065	1,113	1,161	1,210	1,258	1,306	1,355	1,403	1,452	1,500

5. Total

Low Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	14,066,015	165,390	165,250	165,111	165,630	166,152	169,614	170,137	170,659	171,181	171,704	172,212	172,735	173,257	173,779	174,302	174,313	174,324	174,336	174,347	174,358	174,370	174,381	174,408	174,419	174,430	174,442	174,453	174,464	174,476	174,487	174,498	174,568
Without	13,396,551	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390	165,390
Difference	674,101	0	522	1,045	1,567	2,089	4,225	4,747	5,269	5,792	6,314	6,823	7,345	7,868	8,390	8,912	8,924	8,935	8,946	8,958	8,969	8,980	8,992	9,018	9,030	9,041	9,052	9,064	9,075	9,086	9,098	9,109	9,178
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	10,774,085	95,509	104,678	113,848	118,888	119,977	124,585	125,674	126,763	127,852	128,941	129,487	130,576	131,665	132,754	133,843	133,940	134,036	134,133	134,230	134,327	134,423	134,520	134,617	134,714	134,811	134,907	135,004	135,101	135,198	135,294	135,391	135,488
Without	7,736,194	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509	95,509
Difference	3,037,890	0	9,170	18,340	23,379	24,468	29,076	30,165	31,254	32,343	33,432	33,978	35,067	36,156	37,245	38,334	38,431	38,528	38,625	38,721	38,818	38,915	39,012	39,108	39,205	39,302	39,399	39,496	39,592	39,689	39,786	39,883	39,979
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	5,059,983	44,317	50,244	56,172	57,158	57,743	57,475	58,059	58,643	59,228	59,812	60,385	60,970	61,554	62,139	62,723	62,806	62,855	62,903	62,952	63,000	63,048	63,097	63,180	63,229	63,277	63,325	63,374	63,422	63,471	63,519	63,567	63,647
Without	3,589,671	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317	44,317
Difference	1,470,312	0	5,927	11,855	12,841	13,426	13,158	13,742	14,327	14,911	15,495	16,068	16,653	17,237	17,822	18,406	18,490	18,538	18,586	18,635	18,683	18,731	18,780	18,863	18,912	18,960	19,009	19,057	19,105	19,154	19,202	19,250	19,330

Medium Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	13,644,504	156,695	154,467	152,240	158,639	159,113	163,629	164,103	164,577	165,051	165,525	166,166	166,640	167,115	167,589	168,063	168,445	168,470	168,496	168,521	168,546	168,572	168,597	169,013	169,038	169,064	169,089	169,114	169,140	169,165	169,190	169,216	170,064
Without	12,692,277	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695	156,695
Difference	960,331	0	474	948	1,944	2,418	6,934	7,408	7,883	8,357	8,831	9,472	9,946	10,420	10,894	11,368	11,750	11,776	11,801	11,826	11,852	11,877	11,902	12,318	12,344	12,369	12,394	12,420	12,445	12,470	12,496	12,521	13,369
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	10,904,763	95,993	107,460	118,928	123,276	124,361	125,445	126,530	127,615	128,699	129,784	130,871	131,955	133,040	134,125	135,209	135,318	135,428	135,537	135,646	135,755	135,864	135,974	136,083	136,192	136,301	136,410	136,520	136,629	136,738	136,847	136,956	137,065
Without	7,774,904	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986	95,986
Difference	3,129,859	6	11,474	22,941	27,290	28,374	29,459	30,544	31,628	32,713	33,798	34,884	35,969	37,053	38,138	39,223	39,332	39,441	39,550	39,660	39,769	39,878	39,987	40,096	40,206	40,315	40,424	40,533	40,642	40,751	40,861	40,970	41,079
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	5,201,403	44,598	50,550	56,501	58,094	58,674	59,254	59,834	60,413	60,993	61,573	62,153	62,733	63,312	63,892	64,472	64,600	64,649	64,698	64,747	64,797	64,846	64,895	65,008	65,057	65,106	65,155	65,204	65,254	65,303	65,352	65,401	65,486
Without	3,612,471	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598	44,598
Difference	1,588,933	0	5,951	11,903	13,496	14,076	14,655	15,235	15,815	16,395	16,975	17,554	18,134	18,714	19,294	19,873	20,001	20,051	20,100	20,149	20,198	20,247	20,297	20,409	20,458	20,508	20,557	20,606	20,655	20,704	20,754	20,803	20,887

High Case

Paddy Wet (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	13,282,315	145,646	142,783	139,919	148,952	149,876	157,579	158,503	159,428	160,352	161,276	161,087	162,011	162,935	163,859	164,783	165,047	165,062	165,076	165,091	165,106	165,120	165,135	165,396	165,410	165,425	165,439	165,454	165,469	165,483	165,498	165,512	165,972
Without	11,797,354	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646	145,646
Difference	1,496,324	0	924	1,848	3,306	4,230	11,933	12,857	13,781	14,705	15,629	15,441	16,365	17,289	18,213	19,137	19,401	19,415	19,430	19,445	19,459	19,474	19,488	19,749	19,764	19,779	19,793	19,808	19,822	19,837	19,851	19,866	20,326
Paddy Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	10,968,991	94,210	103,716	113,222	119,386	120,515	126,250	127,378	128,507	129,636	130,764	131,844	132,973	134,102	135,230	136,359	136,507	136,605	136,704	136,802	136,900	136,999	137,097	137,252	137,350	137,449	137,547	137,645	137,744	137,842	137,941	138,039	138,170
Without	7,631,011	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210	94,210
Difference	3,337,980	0	9,506	19,012	25,176	26,305	32,040	33,168	34,297	35,426	36,554	37,634	38,763	39,892	41,020	42,149	42,297	42,395	42,494	42,592	42,690	42,789	42,887	43,042	43,140	43,239	43,337	43,435	43,534	43,632	43,731	43,829	43,959
Maize Dry (ha)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051~2100
With	5,029,720	43,850	49,788	55,725	56,680	57,270	56,303	56,892	57,482	58,071	58,660	59,967	60,557	61,146	61,735	62,325	62,461	62,509	62,557	62,606	62,654	62,702	62,751	62,870	62,918	62,966	63,015	63,063	63,112	63,160	63,208	63,257	63,349
Without	3,551,815	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850	43,850
Difference	1,477,905	0	5,938	11,876	12,831	13,420	12,453	13,043	13,632	14,221	14,811	16,118	16,707	17,296	17,886	18,475	18,611	18,659	18,708	18,756	18,805	18,853	18,901	19,020	19,068	19,117	19,165	19,214	19,262	19,310	19,359	19,407	19,500

L2-4 Incremental Water Volume through PDAM (Water Supply Project)

1. Konering

Low,Medium,High Case(m3/day)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050~2100
With	27,464	32,238	37,012	41,786	46,560	51,334	56,572	61,810	67,047	72,285	77,523	83,090	88,658	94,225	99,793	105,360	111,139	116,919	122,698	128,478	134,257	140,208	146,159	152,111	158,062	164,013	170,130	176,248	182,365	188,483	194,600
Without	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205	23,205
Difference	4,259	9,033	13,807	18,581	23,355	28,129	33,367	38,605	43,843	49,081	54,318	59,886	65,453	71,021	76,588	82,155	87,935	93,714	99,494	105,273	111,052	117,004	122,955	128,906	134,857	140,808	146,926	153,043	159,161	165,278	171,395

2. Lematang

Low,Medium,High Case(m3/day)	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040	2,041	2,042	2,043	2,044	2,045	2,046	2,047	2,048	2,049	2050~2100
With	35,313	39,188	43,062	46,937	50,811	54,686	59,040	63,394	67,749	72,103	76,457	81,226	85,995	90,764	95,533	100,302	105,370	110,438	115,507	120,575	125,643	130,871	136,100	141,328	146,557	151,785	157,168	162,550	167,933	173,315	178,698
Without	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000
Difference	3,313	7,188	11,062	14,937	18,811	22,686	27,040	31,394	35,749	40,103	44,457	49,226	53,995	58,764	63,533	68,302	73,370	78,438	83,507	88,575	93,643	98,871	104,100	109,328	114,557	119,785	125,168	130,550	135,933	141,315	146,698

3. Kelingi

Low,Medium,High Case(m3/day)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050~2100
With	18,940	20,381	21,822	23,264	24,705	26,146	27,699	29,252	30,804	32,357	33,910	35,482	37,054	38,626	40,198	41,770	43,417	45,064	46,712	48,359	50,006	51,602	53,198	54,794	56,390	57,986	59,510	61,034	62,558	64,082	65,606
Without	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561	17,561
Difference	1,379	2,820	4,261	5,702	7,144	8,585	10,138	11,690	13,243	14,796	16,349	17,921	19,493	21,065	22,637	24,209	25,856	27,503	29,150	30,798	32,445	34,041	35,637	37,233	38,829	40,425	41,949	43,473	44,997	46,521	48,045

4. Lakitan

Low,Medium,High Case(m3/day)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050~2100
With	10,622	11,572	12,521	13,471	14,420	15,370	16,361	17,352	18,344	19,335	20,326	21,338	22,350	23,363	24,375	25,387	26,388	27,388	28,389	29,389	30,390	31,339	32,288	33,236	34,185	35,134	36,039	36,943	37,848	38,752	39,657
Without	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731	9,731
Difference	891	1,841	2,790	3,740	4,690	5,639	6,630	7,622	8,613	9,604	10,595	11,607	12,620	13,632	14,644	15,656	16,657	17,657	18,658	19,659	20,659	21,608	22,557	23,506	24,454	25,403	26,308	27,212	28,117	29,022	29,926

5. Total

Low,Medium,High Case(m3/day)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050~2100
Water Supply for All Category(m3/Day)																															
With	92,339	103,378	114,418	125,457	136,497	147,536	159,672	171,808	183,944	196,080	208,216	221,137	234,057	246,978	259,898	272,819	286,314	299,810	313,305	326,801	340,296	354,020	367,745	381,469	395,194	408,918	422,847	436,775	450,704	464,632	478,561
Without	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497	82,497
Difference	9,842	20,882	31,921	42,961	54,000	65,039	77,175	89,311	101,447	113,583	125,719	138,640	151,561	164,481	177,402	190,322	203,818	217,313	230,809	244,304	257,799	271,524	285,248	298,973	312,697	326,421	340,350	354,279	368,207	382,136	396,064

L2-5 Incremental Electricity Generated by Hydropower Plant (Water Supply Project)

Komering

Low Case

Hydraulic Power Generation(Mwh)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030~2100
With	48,749	31	46	61	544	544	544	544	544	544	544	631
Without	2,479	31	31	31	31	31	31	31	31	31	31	31
Difference	46,271	0	15	31	513	513	514	514	514	514	514	600

Medium Case

Hydraulic Power Generation(Mwh)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030~2100
With	40,175	25	37	50	448	448	448	448	448	448	448	520
Without	1,993	25	25	25	25	25	25	25	25	25	25	25
Difference	38,183	0	13	25	424	424	424	424	424	424	424	495

High Case

Hydraulic Power Generation(Mwh)	Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030~2100
With	36,339	22	34	45	405	405	405	405	405	405	405	470
Without	1,805	22	22	22	22	22	22	22	22	22	22	22
Difference	34,534	0	11	23	383	383	383	383	383	383	383	448

L2-6 Economic Analysis (Water Supply Project)

M2-6 Economic Analysis (Water Supply Project)

【Low Scenario】 Komering

Economic Cost	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Construction of Tiga Dihaji Dam	3,174.1	2,894.3	IDR	1,058	1,058	1,058				308	308	308	308																														
1.2 Construction of Saka Dam	1,541.3	798.2	IDR																																									
1.3 Development of DMI Water Facility	1,731.7	718.7	IDR	241	1	1	1	216		308	308	308	308	35	1	1	1	209	209	1	1	1	37	37	1	1	201	201	1	1	1	37	37											
1.4 Development of Irrigation Facility	6,218.5	4,655.7	IDR	490	490	490	2,148	2,148	90	90	90	90	90	90																													
2 Compensation,Engineering Service,Physical Contingency	7,808.4	5,589.7	IDR	1,103	955	955	1,325	1,458	379	247	247	247	267	22	1	1	1	129	129	1	1	1	23	23	1	1	124	124	1	1	1	23	23											
3 O&M	15,523.7	1,165.2	IDR	8	47	55	66	77	78	102	104	106	108	130	130	203	130	130	130	151	151	151	174	173	173	246	173	173	173	193	193	193	216	214	214	287	214	214	214	214	214	214	236	214
Total Initial Cost (1.1 ~2)	20,474.1	14,656.6	IDR	2,892	2,504	2,504	3,474	3,822	994	647	647	647	701	57	2	2	2	337	337	2	2	2	60	60	2	2	325	325	2	2	2	60	60										
Total Cost (1.1 ~3)	35,997.8	15,821.8	IDR	2,900	2,551	2,559	3,540	3,899	1,073	749	751	753	809	186	132	205	132	467	467	153	153	153	234	232	174	248	174	497	195	195	195	276	274	214	287	214	214	214	214	214	236	214
Economic Benefit	TOTAL	NPV	(Billion)																																								
1 Irrigation	46,135.2	5,340.9	IDR		226	453	525	525	593	593	593	593	593	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584
2 Water Supply for H.H and Factory	18,716.6	985.0	IDR	7	15	23	31	39	47	56	65	73	82	91	100	110	119	128	138	147	157	167	176	186	196	206	216	226	236	246	256	266	277	287	287	287	287	287	287	287	287	287	287	287
3 Power Generation	142,976.3	14,365.8	IDR		47	94	1,586	1,586	1,586	1,588	1,588	1,588	1,588	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855
Total Economic Benefit	207,828.1	20,691.7	IDR	7	289	570	2,142	2,150	2,228	2,237	2,245	2,254	2,363	2,530	2,539	2,549	2,558	2,567	2,576	2,586	2,596	2,606	2,615	2,625	2,635	2,645	2,655	2,665	2,675	2,685	2,695	2,705	2,716	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726
Cash Flow	TOTAL	NPV	(Billion)																																								
Cashflow	171,830.3	4,869.8	IDR	-2,893	-2,263	-1,989	-1,398	-1,749	1,155	1,487	1,494	1,501	1,454	2,343	2,408	2,343	2,426	2,100	2,109	2,433	2,443	2,452	2,381	2,392	2,461	2,397	2,481	2,167	2,177	2,490	2,500	2,510	2,440	2,452	2,512	2,439	2,512	2,512	2,512	2,512	2,512	2,512	2,489	2,512

Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Construction of Tiga Dihaji Dam			IDR																																								
1.2 Construction of Saka Dam			IDR																																								
1.3 Development of DMI Water Facility			IDR																																								
1.4 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering Service,Physical Contingency			IDR																																								
3 O&M			IDR	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	214	236	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	236	214
Total Initial Cost (1.1 ~2)			IDR																																								
Total Cost (1.1 ~3)			IDR	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	214	236	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	236	214
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584	584
2 Water Supply for H.H and Factory			IDR	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287
3 Power Generation			IDR	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855
Total Economic Benefit			IDR	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726	2,726
Cash Flow			(Billion)																																								
Cashflow			IDR	2,512	2,439	2,512	2,512	2,512	2,512	2,512	2,512	2,489	2,512	2,512	2,439	2,512	2,512	2,512	2,512	2,512	2,512	2,489	2,512	2,512	2,439	2,512	2,512	2,512	2,512	2,512	2,512	2,489	2,512	2,512	2,439	2,512	2,512	2,512	2,512	2,512	2,512	2,512	2,489	2,512
EIRR	13.6%																																										
at Discount Rate of	10.0%																																										
BC	1.3																																										

【Medium Scenario】 Komering

Economic Cost	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Construction of Tiga Dihaji Dam	3,174.1	2,894.3	IDR	1,058	1,058	1,058				308	308	308	308																														
1.2 Construction of Saka Dam	1,541.3	798.2	IDR																																								
1.3 Development of DMI Water Facility	1,731.7	718.7	IDR	241	1	1	1	216		308	308	308	308	35	1	1	1	209	209	1	1	1	37	37	1	1	201	201	1	1	1	37	37											
1.4 Development of Irrigation Facility	6,218.5	4,655.7	IDR	490	490	490	2,148	2,148	90	90	90	90	90	90																													
2 Compensation,Engineering Service,Physical Contingency	7,808.4	5,589.7	IDR	1,103	955	955	1,325	1,458	379	247	247	247	267	22	1	1	1	129	129	1	1	1	23	23	1	1	124	124	1	1	1	23	23											
3 O&M	15,523.7	1,165.2	IDR	8	47	55	66	77	78	102	104	106	108	130	130	203	130	130	130	151	151	151	174	173	173	246	173	173	173	193	193	193	216	214	214	287	214	214	214	214	214	214	236	214
Total Initial Cost (1.1 ~2)	20,474.1	14,656.6	IDR	2,892	2,504	2,504	3,474	3,822	994	647	647	647	701	57	2	2	2	337	337	2	2	2	60	60	2	2	325	325	2	2	2	60	60										
Total Cost (1.1 ~3)	35,997.8	15,821.8	IDR	2,900	2,551	2,559	3,540	3,899	1,073	749	751	753	809	186	132	205	132	467	467	153	153	153	234	232	174	248	174	497	195	195	195	276	274	214	287	214	214	214	214	214	236	214
Economic Benefit	TOTAL	NPV	(Billion)																																								
1 Irrigation	53,129.5	6,138.2	IDR		265	530	609	609	670	670	670	670	670	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673
2 Water Supply for H.H and Factory	18,716.6	985.0	IDR	7	15	23	31	39	47	56	65	73	82	91	100	110	119	128	138	147	157	167	176	186	196	206	216	226	236	246	256	266	277	287	287	287	287	287	287	287	287	287	287	287
3 Power Generation	117,984.3	11,852.6	IDR		39	77	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531
Total Economic Benefit	189,830.4	18,975.8	IDR	7	319	630	1,950	1,958	2,027	2,035	2,044	2,053	2,062	2,295	2,304	2,313	2,323	2,332	2,341	2,351	2,361	2,370	2,380	2,390	2,400	2,410	2,420	2,430	2,440	2,450	2,460	2,470	2,480	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491
Cash Flow	TOTAL	NPV	(Billion)																																								
	153,832.6	3,154.0	IDR	-2,893	-2,232	-1,929	-1,590	-1,941	954	1,286	1,293	1,300	1,252	2,108	2,172	2,108	2,191	1,865	1,874	2,198	2,208	2,217	2,146	2,157	2,225	2,162	2,245	1,932	1,942	2,255	2,265	2,275	2,205	2,217	2,277	2,203	2,277	2,277	2,277	2,277	2,277	2,254	2,277

Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Construction of Tiga Dihaji Dam			IDR																																								
1.2 Construction of Saka Dam			IDR																																								
1.3 Development of DMI Water Facility			IDR																																								
1.4 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering Service,Physical Contingency			IDR																																								
3 O&M			IDR	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	214	236	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	236	214
Total Initial Cost (1.1 ~2)			IDR																																								
Total Cost (1.1 ~3)			IDR	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	214	236	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	236	214
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673
2 Water Supply for H.H and Factory			IDR	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287
3 Power Generation			IDR	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531
Total Economic Benefit			IDR	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491	2,491
Cash Flow			(Billion)																																								
			IDR	2277	2303	2277	2277	2277	2277	2277	2277	2254	2277	2277	2303	2277	2277	2277	2277	2277	2277	2254	2277	2277	2303	2277	2277	2277	2277	2277	2277	2254	2277	2277	2303	2277	2277	2277	2277	2277	2277	2254	2277

EIRR	12.3%	
at Discount Rate of	10.0%	
BC	1.2	

【High Scenario】 Komering

	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost																																											
1.1 Construction of Tiga Dihaji Dam	3,174.1	2,894.3	IDR	1,058	1,058	1,058																																					
1.2 Construction of Saka Dam	1,541.3	798.2	IDR							308	308	308	308																															
1.3 Development of DMI Water Facility	1,731.7	718.7	IDR	241	1	1	1	216	216	90	2	2	35	35		1	1	209	209	1	1	1	37	37	1	1	201	201	1	1	1	37	37											
1.4 Development of Irrigation Facility	6,218.5	4,655.7	IDR	490	490	490	2,148	2,148	90	90	90	90	90																														
2 Compensation,Engineering Service,Physical Contingency	7,808.4	5,589.7	IDR	1,103	955	955	1,325	1,458	379	247	247	247	267	22	1	1	1	129	129	1	1	1	23	23	1	1	124	124	1	1	1	23	23										
3 O&M	15,523.7	1,165.2	IDR	8	47	55	66	77	78	102	104	106	108	130	130	203	130	130	130	151	151	151	173	173	173	246	173	173	193	193	193	214	214	287	214	214	214	214	214	214	214	236	214
Total Initial Cost (1.1~2)	20,474.1	14,656.6	IDR	2,892	2,504	2,504	3,474	3,822	994	647	647	647	701	57	2	2	2	337	337	2	2	2	60	60	2	2	325	325	2	2	2	60	60										
Total Cost (1.1~3)	35,997.8	15,821.8	IDR	2,900	2,551	2,559	3,540	3,899	1,073	749	751	753	809	186	132	205	132	467	467	153	153	153	234	232	174	248	174	497	497	195	195	195	276	274	214	214	214	214	214	214	214	236	214
Economic Benefit	TOTAL	NPV																																									
1 Irrigation	55,565.4	6,234.7	IDR		231	463	561	561	712	712	712	712	712	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707
2 Water Supply for HH and Factory	18,716.6	985.0	IDR	7	15	23	31	39	47	56	65	73	82	91	100	110	119	128	138	147	157	167	176	186	196	206	216	226	236	246	256	266	277	287	287	287	287	287	287	287	287	287	287
3 Power Generation	106,710.4	10,712.3	IDR		35	70	1,182	1,182	1,182	1,182	1,182	1,182	1,182	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385
Total Economic Benefit	180,992.5	17,932.1	IDR	7	281	555	1,774	1,782	1,941	1,950	1,959	1,968	1,976	2,183	2,192	2,201	2,211	2,220	2,229	2,239	2,249	2,258	2,268	2,278	2,288	2,298	2,308	2,318	2,328	2,338	2,348	2,358	2,369	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379
Cash Flow	TOTAL	NPV	(Billion)																																								
	144,994.7	2,110.2	IDR	-2,893	-2,270	-2,004	-1,766	-2,117	869	1,201	1,208	1,214	1,167	4,996	2,061	1,996	2,079	1,753	1,762	2,086	2,096	2,105	2,034	2,045	2,114	2,050	2,133	1,820	1,830	2,143	2,153	2,163	2,093	2,105	2,165	2,091	2,165	2,165	2,165	2,165	2,165	2,142	2,165

				2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
Economic Cost			(Billion)																																								
1.1 Construction of Tiga Dihaji Dam			IDR																																								
1.2 Construction of Saka Dam			IDR																																								
1.3 Development of DMI Water Facility			IDR																																								
1.4 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering Service,Physical Contingency			IDR																																								
3 O&M			IDR	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	236	214	214	214	214	214	214	214	214	236	214	214	214	287	214	214	214	214	214	214	236	214
Total Initial Cost (1.1~2)			IDR																																								
Total Cost (1.1~3)			IDR	214	287	214	214	214	214	214	214	236	214	214	287	214	214	214	214	214	214	236	214	214	214	214	214	214	214	214	236	214	214	214	287	214	214	214	214	214	214	236	214
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707	707
2 Water Supply for HH and Factory			IDR	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287	287
3 Power Generation			IDR	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385
Total Economic Benefit			IDR	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379	2,379
Cash Flow			(Billion)																																								
			IDR	2,165	2,091	2,165	2,165	2,165	2,165	2,165	2,165	2,142	2,165	2,165	2,091	2,165	2,165	2,165	2,165	2,165	2,165	2,142	2,165	2,165	2,165	2,165	2,165	2,165	2,165	2,165	2,165	2,142	2,165	2,165	2,091	2,165	2,165	2,165	2,165	2,165	2,165	2,142	2,165

EIRR	11.5%
at Discount Rate of	10.0%
B/C	1.1

【Low Scenario】 Lematang

Economic Cost	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1.1 Construction of Pandang Bindu Dam	3,654.0	1,174.9	IDR											731	731	731	731	731						
1.2 Construction of Tanjung Agung Dam	6,898.5	1,263.4	IDR																986	986	986	986	986	986
1.3 Construction of Panjung Dam	14,521.5	1,255.7	IDR																					
1.4 Development of DMI Water Facility	1,904.9	741.5	IDR	246				202	202	1	1	1	62	62	1	1	1	216	216	1	1	1	62	62
1.5 Development of Irrigation Facility	3,332.8	562.8	IDR											173	173	173	173	173	105	105	105	105	105	105
2 Compensation,Engineering Service,Physical Contingency	18,687.2	3,081.4	IDR	152				125	125	1	1	1	38	596	558	558	558	691	806	673	673	673	711	711
3 O&M	18,732.2	841.9	IDR		31	31	31	31	31	48	48	48	48	70	74	79	83	88	93	118	123	129	134	159
Total Initial Cost (1.1～2)	48,998.9	8,079.6	IDR	397				327	327	2	2	2	101	1,562	1,463	1,463	1,463	1,811	2,112	1,764	1,764	1,764	1,864	1,864
Total Cost (1.1～3)	67,731.1	8,921.5	IDR	397	31	31	31	358	358	49	49	49	149	1,632	1,537	1,542	1,546	1,899	2,206	1,882	1,888	1,893	1,998	2,022
Economic Benefit	TOTAL	NPV	(Billion)																					
1 Irrigation	34,516.6	2,706.9	IDR		33	67	100	134	167	200	234	267	301	334	367	401	434	467	468	468	468	468	468	468
2 Water Supply for H.H and Factory	15,954.5	821.1	IDR	6	12	19	25	31	38	45	53	60	67	74	82	90	98	106	114	123	131	140	148	157
Total Economic Benefit	50,471.1	3,527.9	IDR	6	45	85	125	165	205	246	286	327	368	408	450	491	532	574	582	591	599	608	616	625
Cash Flow	TOTAL	NPV	(Billion)																					
	-17,260.0	-5,393.6	IDR	-392	14	54	94	-193	-153	196	237	278	219	-1,224	-1,088	-1,051	-1,014	-1,325	-1,623	-1,291	-1,288	-1,285	-1,381	-1,398

Economic Cost	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Construction of Pandang Bindu Dam																				
1.2 Construction of Tanjung Agung Dam	986																			
1.3 Construction of Panjung Dam		1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614										
1.4 Development of DMI Water Facility	1	1	1	216	216	1	1	1	62	62										
1.5 Development of Irrigation Facility	105	192	192	192	192	192	192	192	192	192										
2 Compensation,Engineering Service,Physical Contingency	673	1,114	1,114	1,247	1,247	1,114	1,114	1,114	1,152	1,152										
3 O&M	164	173	182	235	200	229	238	247	256	284	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1～2)	1,764	2,921	2,921	3,269	3,269	2,921	2,921	2,921	3,020	3,020										
Total Cost (1.1～3)	1,929	3,094	3,103	3,503	3,469	3,149	3,158	3,168	3,276	3,304	321	284	284	327	284	284	284	284	284	370
Economic Benefit																				
1 Irrigation	468	469	469	469	469	469	469	469	469	469	470	470	470	470	470	470	470	470	470	470
2 Water Supply for H.H and Factory	166	174	183	192	201	210	219	228	237	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	634	643	652	661	669	678	687	696	705	714	716	716	716	716	716	716	716	716	716	716
Cash Flow																				
	-1,295	-2,451	-2,451	-2,842	-2,799	-2,471	-2,471	-2,471	-2,570	-2,590	395	432	432	389	432	432	432	432	432	345

Economic Cost	(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080
1.1 Construction of Pandang Bindu Dam	IDR																				
1.2 Construction of Tanjung Agung Dam	IDR																				
1.3 Construction of Panjung Dam	IDR																				
1.4 Development of DMI Water Facility	IDR																				
1.5 Development of Irrigation Facility	IDR																				
2 Compensation,Engineering Service,Physical Contingency	IDR																				
3 O&M	IDR	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1～2)	IDR																				
Total Cost (1.1～3)	IDR	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Economic Benefit	(Billion)																				
1 Irrigation	IDR	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470
2 Water Supply for H.H and Factory	IDR	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	IDR	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716
Cash Flow	(Billion)																				
	IDR	395	432	432	389	432	432	432	432	432	345	395	432	432	389	432	432	432	432	432	345

Economic Cost	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Construction of Pandang Bindu Dam																				
1.2 Construction of Tanjung Agung Dam																				
1.3 Construction of Panjung Dam																				
1.4 Development of DMI Water Facility																				
1.5 Development of Irrigation Facility																				
2 Compensation,Engineering Service,Physical Contingency																				
3 O&M	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1～2)																				
Total Cost (1.1～3)	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Economic Benefit																				
1 Irrigation	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470
2 Water Supply for H.H and Factory	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716	716
Cash Flow																				
	395	432	432	389	432	432	432	432	432	345	395	432	432	389	432	432	432	432	432	345

EIRR	N/A
at Discount Rate of	10.0%
B/C	0.4

【Medium Scenario】 Lematang

Economic Cost	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1.1 Construction of Pandang Bindu Dam	3,654.0	1,174.9	IDR											731	731	731	731	731						
1.2 Construction of Tanjung Agung Dam	6,898.5	1,263.4	IDR																986	986	986	986	986	986
1.3 Construction of Panjung Dam	14,521.5	1,255.7	IDR																					
1.4 Development of DMI Water Facility	1,904.9	741.5	IDR	246				202	202	1	1	1	62	62	1	1	1	216	216	1	1	1	62	62
1.5 Development of Irrigation Facility	3,332.8	562.8	IDR											173	173	173	173	173	105	105	105	105	105	105
2 Compensation,Engineering Service,Physical Contingency	18,687.2	3,081.4	IDR	152				125	125	1	1	1	38	596	558	558	558	691	806	673	673	673	711	711
3 O&M	18,732.2	841.9	IDR		31	31	31	31	31	48	48	48	48	70	74	79	83	88	93	118	123	129	134	159
Total Initial Cost (1.1～2)	48,998.9	8,079.6	IDR	397				327	327	2	2	2	101	1,562	1,463	1,463	1,463	1,811	2,112	1,764	1,764	1,764	1,864	1,864
Total Cost (1.1～3)	67,731.1	8,921.5	IDR	397	31	31	31	358	358	49	49	49	149	1,632	1,537	1,542	1,546	1,899	2,206	1,882	1,888	1,893	1,998	2,022
Economic Benefit	TOTAL	NPV	(Billion)																					
1 Irrigation	34,515.5	2,632.0	IDR		32	64	96	128	160	192	225	257	289	321	353	385	417	449	456	456	456	456	456	456
2 Water Supply for H.H and Factory	15,954.5	821.1	IDR	6	12	19	25	31	38	45	53	60	67	74	82	90	98	106	114	123	131	140	148	157
Total Economic Benefit	50,470.0	3,453.1	IDR	6	44	83	121	160	198	238	277	317	356	395	435	475	515	556	570	579	587	596	604	613
Cash Flow	TOTAL	NPV	(Billion)																					
	-17,261.1	-5,468.5	IDR	-392	13	51	90	-198	-160	188	228	267	207	-1,237	-1,102	-1,066	-1,031	-1,343	-1,635	-1,303	-1,300	-1,297	-1,394	-1,410

Economic Cost	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Construction of Pandang Bindu Dam																				
1.2 Construction of Tanjung Agung Dam	986																			
1.3 Construction of Panjung Dam		1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614										
1.4 Development of DMI Water Facility	1	1	1	216	216	1	1	1	62	62										
1.5 Development of Irrigation Facility	105	192	192	192	192	192	192	192	192	192										
2 Compensation,Engineering Service,Physical Contingency	673	1,114	1,114	1,247	1,247	1,114	1,114	1,114	1,152	1,152										
3 O&M	164	173	182	235	200	229	238	247	256	284	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1～2)	1,764	2,921	2,921	3,269	3,269	2,921	2,921	2,921	3,020	3,020										
Total Cost (1.1～3)	1,929	3,094	3,103	3,503	3,469	3,149	3,158	3,168	3,276	3,304	321	284	284	327	284	284	284	284	284	370
Economic Benefit																				
1 Irrigation	456	463	463	463	463	463	463	463	463	463	476	476	476	476	476	476	476	476	476	476
2 Water Supply for H.H and Factory	166	174	183	192	201	210	219	228	237	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	621	637	646	655	663	672	681	690	699	708	721	721	721	721	721	721	721	721	721	721
Cash Flow																				
	-1,307	-2,457	-2,457	-2,849	-2,806	-2,477	-2,477	-2,477	-2,576	-2,596	401	438	438	394	438	438	438	438	438	351

Economic Cost	(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080
1.1 Construction of Pandang Bindu Dam	IDR																				
1.2 Construction of Tanjung Agung Dam	IDR																				
1.3 Construction of Panjung Dam	IDR																				
1.4 Development of DMI Water Facility	IDR																				
1.5 Development of Irrigation Facility	IDR																				
2 Compensation,Engineering Service,Physical Contingency	IDR																				
3 O&M	IDR	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1～2)	IDR																				
Total Cost (1.1～3)	IDR	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Economic Benefit	(Billion)																				
1 Irrigation	IDR	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476
2 Water Supply for H.H and Factory	IDR	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	IDR	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721
Cash Flow	(Billion)																				
	IDR	401	438	438	394	438	438	438	438	438	351	401	438	438	394	438	438	438	438	438	351

Economic Cost	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Construction of Pandang Bindu Dam																				
1.2 Construction of Tanjung Agung Dam																				
1.3 Construction of Panjung Dam																				
1.4 Development of DMI Water Facility																				
1.5 Development of Irrigation Facility																				
2 Compensation,Engineering Service,Physical Contingency																				
3 O&M	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1～2)																				
Total Cost (1.1～3)	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Economic Benefit																				
1 Irrigation	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476	476
2 Water Supply for H.H and Factory	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721	721
Cash Flow																				
	401	438	438	394	438	438	438	438	438	351	401	438	438	394	438	438	438	438	438	351

EIRR	N/A
at Discount Rate of	10.0%
B/C	0.4

【High Scenario】 Lematang

Economic Cost	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Construction of Pandang Bindu Dam	3,654.0	1,174.9	IDR												731	731	731	731																											
1.2 Construction of Tanjung Agung Dam	6,898.5	1,263.4	IDR																986	986	986	986	986	986	986	986																			
1.3 Construction of Panjung Dam	14,521.5	1,255.7	IDR																							1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614												
1.4 Development of DMI Water Facility	1,904.9	741.5	IDR	246				202	202	1	1	1	62	62	173	173	173	173	216	216	1	105	1	62	62	105	1	192	192	216	192	192	192	62	192									
1.5 Development of Irrigation Facility	3,332.8	562.8	IDR											173	173	173	173	173	105	105	105	105	105	105	105	105	192	192	192	192	192	192	192	192										
2 Compensation,Engineering Service,Physical Contingency	18,687.2	3,081.4	IDR	152				125	125	1	1	1	38	596	558	558	558	691	806	673	673	673	673	711	711	673	1,114	1,114	1,247	1,247	1,247	1,114	1,114	1,152	1,152										
3 O&M	18,732.2	841.9	IDR		31	31	31	31	31	48	48	48	48	70	74	79	83	88	93	118	123	129	134	159	164	173	182	235	200	229	238	284	256	284	284	284	284	284	284	284	284	284	284	370
Total Initial Cost (1.1~2)	48,998.9	8,079.6	IDR	397				327	327	2	2	2	101	1,562	1,463	1,463	1,463	1,811	2,112	1,764	1,764	1,764	1,864	1,864	1,764	2,921	2,921	3,269	3,269	2,921	2,921	2,921	2,921	3,020	3,020										
Total Cost (1.1~3)	67,731.1	8,921.5	IDR	397	31	31	31	358	358	49	49	49	149	1,632	1,537	1,542	1,546	1,899	2,206	1,882	1,888	1,893	1,998	2,022	1,929	3,094	3,103	3,503	3,469	3,149	3,158	3,168	3,276	3,304	321	284	284	327	284	284	284	284	284	370
Economic Benefit	TOTAL	NPV	(Billion)																																									
1 Irrigation	42,398.2	3,274.3	IDR		40	80	120	160	200	241	281	321	361	401	441	481	521	561	567	567	567	567	567	567	567	573	573	573	573	573	573	573	573	573	581	581	581	581	581	581	581	581	581	581
2 Water Supply for H.H and Factory	15,954.5	821.1	IDR	6	12	19	25	31	38	45	53	60	67	74	82	90	98	106	114	123	131	140	148	157	166	174	183	192	201	210	219	228	237	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	58,352.6	4,095.4	IDR	6	52	99	145	192	238	286	333	381	428	475	523	571	620	668	682	690	699	707	716	724	733	747	756	765	774	783	792	801	810	819	827	827	827	827	827	827	827	827	827	827
Cash Flow	TOTAL	NPV	(Billion)																																									
	-9,378.5	-4,826.1	IDR	-392	21	67	114	-166	-120	237	284	331	279	-1,157	-1,014	-970	-927	-1,231	-1,524	-1,192	-1,189	-1,186	-1,282	-1,298	-1,196	-2,347	-2,347	-2,738	-2,695	-2,367	-2,367	-2,367	-2,466	-2,485	506	543	543	500	543	543	543	543	543	456

Economic Cost	(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Construction of Pandang Bindu Dam	IDR																																								
1.2 Construction of Tanjung Agung Dam	IDR																																								
1.3 Construction of Panjung Dam	IDR																																								
1.4 Development of DMI Water Facility	IDR																																								
1.5 Development of Irrigation Facility	IDR																																								
2 Compensation,Engineering Service,Physical Contingency	IDR																																								
3 O&M	IDR	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Total Initial Cost (1.1~2)	IDR																																								
Total Cost (1.1~3)	IDR	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370	321	284	284	327	284	284	284	284	284	370
Economic Benefit	(Billion)																																								
1 Irrigation	IDR	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
2 Water Supply for H.H and Factory	IDR	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246
Total Economic Benefit	IDR	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827
Cash Flow	(Billion)																																								
	IDR	506	543	543	500	543	543	543	543	543	456	506	543	543	500	543	543	543	543	543	456	506	543	543	500	543	543	543	543	543	456	506	543	543	500	543	543	543	543	543	456

EIRR	N/A
at Discount Rate of	10.0%
B/C	0.5

【Low Scenario】 Kelingi

	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost																																												
1.1 Development of DMI Water Facility	667.9	288.2	IDR	115	1	1	1	71	71	1	1	1	23	23	1	1	1	72	72	1	1	1	23	23	1	1	1	38	38	1	1	1	40	40										
1.2 Development of Irrigation Facility	557.1	187.4	IDR	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18										
2 Compensation,Engineering																																												
2 Service,Physical Contingency	755.3	293.2	IDR	82	12	12	12	55	55	12	12	12	25	25	12	12	12	55	55	12	12	12	25	25	12	12	12	35	35	12	12	12	36	36										
3 O&M	4,119.7	337.5	IDR	0	23	23	23	23	23	29	29	30	30	45	36	36	36	36	37	43	43	43	43	43	67	49	49	49	49	49	54	55	55	55	82	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)	1,980.4	768.7	IDR	215	30	30	30	145	145	31	31	31	66	66	31	31	31	145	145	31	31	31	66	66	30	30	30	91	91	31	31	31	94											
Total Cost(1.1 ~ 3)	6,100.1	1,106.3	IDR	215	53	53	53	167	167	60	60	61	95	111	67	67	67	182	182	73	74	74	108	132	79	79	79	140	140	85	85	86	149	176	55	55	55	55	55	55	55	55	55	83
Economic Benefit	TOTAL	NPV	(Billion)																																									
1 Irrigation	125.2	6.5	IDR		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2 Water Supply for H.H and Factory	5,291.6	289.2	IDR	2	5	7	10	12	14	17	20	22	25	27	30	33	35	38	41	43	46	49	52	54	57	60	62	65	68	70	73	75	78	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit	5,416.8	295.6	IDR	2	5	7	10	12	15	17	20	23	25	28	31	33	36	39	41	44	47	50	53	56	58	61	64	67	69	72	74	77	80	82	82	82	82	82	82	82	82	82	82	82
Cash Flow	TOTAL	NPV	(Billion)																																									
Cash flow	-683.3	-310.7	IDR	-213	-48	-46	-43	-155	-153	-43	-40	-38	-70	-83	-36	-34	-31	-143	-140	-29	-26	-24	-56	-77	-21	-18	-16	-73	-71	-14	-11	-8	-70	-94	28	28	28	28	28	28	28	28	28	-0

Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Development of DMI Water Facility			IDR																																								
1.2 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering																																											
2 Service,Physical Contingency			IDR																																								
3 O&M			IDR	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)			IDR																																								
Total Cost(1.1 ~ 3)			IDR	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2 Water Supply for H.H and Factory			IDR	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit			IDR	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82
Cash Flow			(Billion)																																									
Cash flow			IDR	28	28	28	28	28	28	28	28	28	-0	28	28	28	28	28	28	28	28	28	-0	28	28	28	28	28	28	28	28	28	-0	28	28	28	28	28	28	28	28	28	-0

EIRR	N/A
at Discount Rate of	10.0%
BC	0.3

【Medium Scenario】 Kelingi

	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost																																												
1.1 Development of DMI Water Facility	667.9	288.2	IDR	115	1	1	1	71	71	1	1	1	23	23	1	1	1	72	72	1	1	1	23	23	1	1	1	38	38	1	1	1	40	40										
1.2 Development of Irrigation Facility	557.1	187.4	IDR	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18										
2 Compensation,Engineering																																												
2 Service,Physical Contingency	755.3	293.2	IDR	82	12	12	12	55	55	12	12	12	25	25	12	12	12	55	55	12	12	12	25	25	12	12	12	35	35	12	12	12	36	36										
3 O&M	4,119.7	337.5	IDR	0	23	23	23	23	23	29	29	30	30	45	36	36	36	36	37	43	43	43	43	43	67	49	49	49	49	49	54	55	55	55	82	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)	1,980.4	768.7	IDR	215	30	30	30	145	145	31	31	31	66	66	31	31	31	145	145	31	31	31	66	66	30	30	30	91	91	31	31	31	94											
Total Cost(1.1 ~ 3)	6,100.1	1,106.3	IDR	215	53	53	53	167	167	60	60	61	95	111	67	67	67	182	182	73	74	74	108	132	79	79	79	140	140	85	85	86	149	176	55	55	55	55	55	55	55	55	55	83
Economic Benefit	TOTAL	NPV	(Billion)																																									
1 Irrigation	649.4	33.6	IDR		0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10	10	10	10	10	10	10	10	10
2 Water Supply for H.H and Factory	5,291.6	289.2	IDR	2	5	7	10	12	14	17	20	22	25	27	30	33	35	38	41	43	46	49	52	54	57	60	62	65	68	70	73	75	78	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit	5,941.0	322.7	IDR	2	5	8	11	13	16	19	22	25	28	31	34	37	39	42	45	48	52	55	58	61	64	67	70	73	76	79	81	84	87	90	90	90	90	90	90	90	90	90	90	90
Cash Flow	TOTAL	NPV	(Billion)																																									
Cash flow	-159.1	-783.6	IDR	-213	-48	-45	-43	-154	-152	-41	-39	-36	-68	-80	-34	-31	-28	-139	-136	-25	-22	-19	-51	-71	-15	-12	-10	-67	-64	-7	-4	-1	-62	-86	36	36	36	36	36	36	36	36	36	8

Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Development of DMI Water Facility			IDR																																								
1.2 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering																																											
2 Service,Physical Contingency			IDR																																								
3 O&M			IDR	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)			IDR																																								
Total Cost(1.1 ~ 3)			IDR	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Economic Benefit			(Billion)																																									
1 Irrigation			IDR	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2 Water Supply for H.H and Factory			IDR	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit			IDR	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Cash Flow			(Billion)																																									
Cash flow			IDR	36	36	36	36	36	36	36	36	36	8	36	36	36	36	36	36	36	36	36	8	36	36	36	36	36	36	36	36	36	8	36	36	36	36	36	36	36	36	36	8

EIRR	N/A
at Discount Rate of	10.0%
BC	0.3

【High Scenario】 Kelimgi

Economic Cost	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1.1 Development of DMI Water Facility	667.9	288.2	IDR	115	1	1	1	71	71	1	1	1	23	23	1	1	1	72	72	1	1	1	23	23
1.2 Development of Irrigation Facility	557.1	187.4	IDR	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
2 Compensation,Engineering Service,Physical Contingency	755.3	293.2	IDR	82	12	12	12	55	55	12	12	12	25	25	12	12	12	55	55	12	12	12	25	25
3 O&M	4,119.7	337.5	IDR	0	23	23	23	23	23	29	29	30	30	45	36	36	36	36	37	43	43	43	43	67
Total Initial Cost (1.1~2)	1,980.4	768.7	IDR	215	30	30	30	145	145	31	31	31	66	66	31	31	31	145	145	31	31	31	66	66
Total Cost(1.1～3)	6,100.1	1,106.3	IDR	215	53	53	53	167	167	60	60	61	95	111	67	67	67	182	182	73	74	74	108	132
Economic Benefit	**TOTAL**	**NPV**	**(Billion)**																					
1 Irrigation	202.9	10.5	IDR		0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
2 Water Supply for H.H and Factory	5,291.6	289.2	IDR	2	5	7	10	12	14	17	20	22	25	27	30	33	35	38	41	43	46	49	52	54
Total Economic Benefit	5,494.5	299.6	IDR	2	5	7	10	12	15	18	20	23	26	28	31	34	37	39	42	45	48	51	53	56
Cash Flow	**TOTAL**	**NPV**	**(Billion)**																					
Cashflow	-605.6	-806.6	IDR	-213	-48	-46	-43	-155	-153	-43	-40	-38	-70	-82	-36	-33	-31	-142	-140	-29	-26	-23	-55	-76

Economic Cost	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Development of DMI Water Facility	1	1	1	38	38	1	1	1	40	40										
1.2 Development of Irrigation Facility	18	18	18	18	18	18	18	18	18	18										
2 Compensation,Engineering Service,Physical Contingency	12	12	12	35	35	12	12	12	36	36										
3 O&M	49	49	49	49	49	54	55	55	55	82	55	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)	30	30	30	91	91	31	31	31	94	94										
Total Cost(1.1～3)	79	79	79	140	140	85	85	86	149	176	55	55	55	55	55	55	55	55	55	83
Economic Benefit																				
1 Irrigation	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2 Water Supply for H.H and Factory	57	60	62	65	68	70	73	75	78	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit	59	62	65	67	70	73	76	78	81	83	84	84	84	84	84	84	84	84	84	84
Cash Flow																				
Cashflow	-20	-17	-15	-72	-70	-13	-10	-7	-68	-93	29	29	29	29	29	29	29	29	29	1

Economic Cost	(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080
1.1 Development of DMI Water Facility	IDR																				
1.2 Development of Irrigation Facility	IDR																				
2 Compensation,Engineering Service,Physical Contingency	IDR																				
3 O&M	IDR	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)	IDR																				
Total Cost(1.1～3)	IDR	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Economic Benefit	**(Billion)**																				
1 Irrigation	IDR	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2 Water Supply for H.H and Factory	IDR	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit	IDR	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
Cash Flow	**(Billion)**																				
Cashflow	IDR	29	29	29	29	29	29	29	29	29	1	29	29	29	29	29	29	29	29	29	1

Economic Cost	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Development of DMI Water Facility																				
1.2 Development of Irrigation Facility																				
2 Compensation,Engineering Service,Physical Contingency																				
3 O&M	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Total Initial Cost (1.1~2)																				
Total Cost(1.1～3)	55	55	55	55	55	55	55	55	55	83	55	55	55	55	55	55	55	55	55	83
Economic Benefit																				
1 Irrigation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2 Water Supply for H.H and Factory	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Total Economic Benefit	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
Cash Flow																				
Cashflow	29	29	29	29	29	29	29	29	29	1	29	29	29	29	29	29	29	29	29	1

EIRR	N/A
at Discount Rate of	10.0%
B/C	0.3

【Low Scenario】Lakitan

	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Development of DMI Water Facility	413.2	172.0	(Billion) IDR	66	1	1	1	45	45	0	0	0	15	15	1	1	1	32	32	1	1	1	24	24	1	1	28	28	1	1	1	24	24									
1.2 Development of Irrigation Facility	887.2	298.4	IDR	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29									
2 Compensation,Engineering Service,Physical Contingency	801.7	290.0	IDR	58	18	18	18	45	45	18	18	18	27	27	18	18	18	37	37	18	18	18	33	33	18	18	35	35	18	18	18	33	33									
3 O&M	2,839.3	221.5	IDR	0	14	14	14	14	14	18	19	19	19	37	23	23	23	24	27	27	27	28	28	57	31	32	32	32	35	35	35	35	78	36	36	36	36	36	36	36	36	36	80
Total Initial Cost (1.1~2)	2,102.1	760.5	IDR	153	47	47	47	118	118	47	47	47	70	70	47	47	47	98	98	47	47	47	85	85	47	47	91	91	47	47	47	85	85										
Total Cost(1.1~3)	4,941.4	981.9	IDR	153	61	61	61	133	133	65	66	66	89	107	70	71	71	121	121	75	75	75	113	142	79	79	123	123	82	82	83	83	121	164	50	50	50	50	50	50	50	50	50
Economic Benefit	TOTAL	NPV	(Billion)																																								
1 Irrigation	5,136.6	265.4	IDR		3	5	8	10	13	15	18	20	23	25	28	31	33	36	38	41	43	46	48	51	54	56	59	61	64	66	69	71	74	76	79	79	79	79	79	79	79	79	79
2 Water Supply for H.H and Factory	3,312.6	185.1	IDR	1	3	5	6	8	9	11	13	14	16	18	19	21	23	25	26	28	30	31	33	35	36	38	39	41	43	44	46	47	49	50	50	50	50	50	50	50	50	50	50
Total Economic Benefit	8,449.2	450.5	IDR	1	6	10	14	18	22	26	31	35	39	43	47	52	56	60	64	69	73	77	81	86	90	94	98	102	106	110	114	118	123	127	129	129	129	129	129	129	129	129	129
Cash Flow	TOTAL	NPV	(Billion)																																								
Cashflow	3,507.8	-531.5	IDR	-151	-55	-51	-47	-114	-110	-39	-35	-31	-50	-64	-23	-19	-15	-61	-57	-6	-2	2	-32	-56	11	15	19	-21	-17	28	32	36	2	-37	94	94	94	94	94	94	94	94	49
Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	
1.1 Development of DMI Water Facility			IDR																																								
1.2 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering Service,Physical Contingency			IDR																																								
3 O&M			IDR	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	
Total Initial Cost (1.1~2)			IDR																																								
Total Cost(1.1~3)			IDR	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	
2 Water Supply for H.H and Factory			IDR	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
Total Economic Benefit			IDR	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	
Cash Flow			(Billion)																																								
Cashflow			IDR	94	94	94	94	94	94	94	94	94	49	94	94	94	94	94	94	94	94	94	49	94	94	94	94	94	94	94	94	94	49	94	94	94	94	94	94	94	94	94	49	

EIRR	3.4%
at Discount Rate of	10.0%
B/C	0.5

【Medium Scenario】Lakitan

	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
1.1 Development of DMI Water Facility	413.2	172.0	(Billion) IDR	66	1	1	1	45	45	0	0	0	15	15	1	1	1	32	32	1	1	1	24	24	1	1	28	28	1	1	1	24	24									
1.2 Development of Irrigation Facility	887.2	298.4	IDR	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29									
2 Compensation,Engineering Service,Physical Contingency	801.7	290.0	IDR	58	18	18	18	45	45	18	18	18	27	27	18	18	18	37	37	18	18	18	33	33	18	18	35	35	18	18	18	33	33									
3 O&M	2,839.3	221.5	IDR	0	14	14	14	14	14	18	19	19	19	37	23	23	23	24	27	27	27	28	28	57	31	32	32	32	35	35	35	35	78	36	36	36	36	36	36	36	36	36	80
Total Initial Cost (1.1~2)	2,102.1	760.5	IDR	153	47	47	47	118	118	47	47	47	70	70	47	47	47	98	98	47	47	47	85	85	47	47	91	91	47	47	47	85	85										
Total Cost(1.1~3)	4,941.4	981.9	IDR	153	61	61	61	133	133	65	66	66	89	107	70	71	71	121	121	75	75	75	113	142	79	79	123	123	82	82	83	83	121	164	50	50	50	50	50	50	50	50	50
Economic Benefit	TOTAL	NPV	(Billion)																																								
1 Irrigation	5,489.2	284.3	IDR	0	3	6	8	11	14	16	19	22	25	27	30	33	35	38	41	44	46	49	52	55	57	60	63	65	68	71	74	76	79	82	84	84	84	84	84	84	84	84	84
2 Water Supply for H.H and Factory	3,312.6	185.1	IDR	1	3	5	6	8	9	11	13	14	16	18	19	21	23	25	26	28	30	31	33	35	36	38	39	41	43	44	46	47	49	50	50	50	50	50	50	50	50	50	50
Total Economic Benefit	8,801.8	469.4	IDR	2	6	10	15	19	23	28	32	36	41	45	49	54	58	63	67	72	76	80	85	89	93	98	102	106	111	115	119	123	128	132	135	135	135	135	135	135	135	135	135
Cash Flow	TOTAL	NPV	(Billion)																																								
Cashflow	3,860.4	-512.5	IDR	-151	-55	-51	-47	-114	-110	-38	-34	-29	-48	-62	-21	-17	-12	-58	-54	-3	1	5	-28	-53	15	19	23	-17	-13	33	37	41	7	-32	99	99	99	99	99	99	99	99	55
Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	
1.1 Development of DMI Water Facility			IDR																																								
1.2 Development of Irrigation Facility			IDR																																								
2 Compensation,Engineering Service,Physical Contingency			IDR																																								
3 O&M			IDR	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	
Total Initial Cost (1.1~2)			IDR																																								
Total Cost(1.1~3)			IDR	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	
2 Water Supply for H.H and Factory			IDR	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	
Total Economic Benefit			IDR	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	
Cash Flow			(Billion)																																								
Cashflow			IDR	99	99	99	99	99	99	99	99	99	55	99	99	99	99	99	99	99	99	99	55	99	99	99	99	99	99	99	99	99	55	99	99	99	99	99	99	99	99	99	55	

EIRR	3.7%
at Discount Rate of	10.0%
B/C	0.5

【High Scenario】 Ladtan

	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost			(Billion)																																								
1.1 Development of DMI Water Facility	413.2	172.0	IDR	66	1	1	1	45	45	0	0	0	15	15	1	1	1	32	32	1	1	1	24	24	1	1	1	28	28	1	1	1	24	24									
1.2 Development of Irrigation Facility	887.2	298.4	IDR	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29									
Compensation,Engineering																																											
2 Service,Physical Contingency	801.7	290.0	IDR	58	18	18	18	45	45	18	18	18	27	27	18	18	18	37	37	18	18	18	33	33	18	18	18	35	35	18	18	18	33	33									
3 O&M	2,839.3	221.5	IDR	0	14	14	14	14	14	18	19	19	19	37	23	23	23	23	24	27	27	28	28	57	31	32	32	32	32	35	35	35	35	78	36	36	36	36	36	36	36	36	80
Total Initial Cost (1.1~2)	2,102.1	760.5	IDR	153	47	47	47	118	118	47	47	47	70	70	47	47	47	98	98	47	47	47	85	85	47	47	47	91	91	47	47	47	85	85									
Total Cost(1.1~3)	4,941.4	981.9	IDR	153	61	61	61	133	133	65	66	66	89	107	70	71	71	121	121	75	75	75	113	142	79	79	79	123	123	82	83	83	121	164	36	36	36	36	36	36	36	36	80
Economic Benefit	TOTAL	NPV	(Billion)																																								
1 Irrigation	5,211.5	269.3	IDR		3	5	8	10	13	16	18	21	23	26	28	31	34	36	39	41	44	47	49	52	54	57	59	62	65	67	70	72	75	78	80	80	80	80	80	80	80	80	80
2 Water Supply for H.H and Factory	3,312.6	185.1	IDR	1	3	5	6	8	9	11	11	13	16	18	19	21	23	25	26	28	30	31	33	35	36	38	39	41	43	44	46	47	49	50	50	50	50	50	50	50	50	50	50
Total Economic Benefit	8,524.1	454.4	IDR	1	6	10	14	18	22	27	31	35	39	44	48	52	56	61	65	69	74	78	82	86	90	95	99	103	107	111	115	119	124	128	130	130	130	130	130	130	130	130	130
Cash Flow	TOTAL	NPV	(Billion)																																								
Cashflow	3,582.7	-527.6	IDR	-151	-55	-51	-47	-114	-110	-39	-35	-31	-50	-64	-23	-18	-14	-60	-56	-5	-1	3	-31	-56	12	16	20	-20	-16	29	33	37	3	-36	95	95	95	95	95	95	95	95	50

Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1.1 Development of DMI Water Facility			IDR																																								
1.2 Development of Irrigation Facility			IDR																																								
Compensation,Engineering																																										
2 Service,Physical Contingency			IDR																																								
3 O&M			IDR	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80
Total Initial Cost (1.1~2)			IDR																																								
Total Cost(1.1~3)			IDR	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80	36	36	36	36	36	36	36	36	36	80
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
2 Water Supply for H.H and Factory			IDR	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Total Economic Benefit			IDR	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
Cash Flow			(Billion)																																								
Cashflow			IDR	95	95	95	95	95	95	95	95	95	50	95	95	95	95	95	95	95	95	95	50	95	95	95	95	95	95	95	95	95	50	95	95	95	95	95	95	95	95	95	50

EIRR	3.5%
at Discount Rate of	10.0%
B/C	0.5

【Low Scenario】All

	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost																																												
1 Direct Cost Total	45,502.9	15,011.1	IDR	2,263	1,597	1,597	2,197	2,730	980	450	450	580	1,088	955	955	588	588	1,479	1,666	1,141	1,141	1,141	1,283	1,283	1,141	1,856	1,856	2,336	1,856	1,856	1,856	2,017	2,017											
2 Compensation,Engineering Service,Physical Contingency	28,052.6	9,254.3	IDR	1,395	985	985	1,355	1,683	604	277	277	277	358	669	588	588	588	912	1,027	703	703	703	791	791	703	1,144	1,144	1,440	1,440	1,145	1,145	1,145	1,243	1,243											
3 O&M	41,214.9	2,566.2	IDR	8	115	123	134	145	147	198	200	202	204	282	263	342	273	278	283	339	345	350	379	454	417	500	435	488	454	511	520	530	562	658	625	662	588	631	588	588	588	588	588	611	747
Total Initial Cost (1~2)	73,555.5	24,265.4	IDR	3,657	2,582	2,582	3,552	4,412	1,584	727	727	938	1,755	1,543	1,543	1,543	1,543	2,391	2,692	1,845	1,845	1,845	2,075	2,075	1,844	3,000	3,000	3,776	3,776	3,001	3,001	3,260	3,260	3,260											
Total Cost (1~3)	114,770.4	26,831.6	IDR	3,665	2,697	2,704	3,686	4,557	1,731	924	927	929	1,142	2,037	1,806	1,885	1,816	2,669	2,976	2,183	2,189	2,195	2,453	2,529	2,261	3,500	3,436	4,264	4,230	3,512	3,521	3,531	3,822	3,918	625	662	588	631	588	588	588	588	588	747
Economic Benefit	TOTAL	NPV	(Billion)																																									
1 Irrigation	85,913.7	8,319.7	IDR		262	525	633	669	773	809	845	881	917	944	980	1,016	1,052	1,088	1,091	1,094	1,096	1,099	1,101	1,104	1,107	1,110	1,113	1,115	1,118	1,120	1,123	1,126	1,128	1,131	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
2 Water Supply for H.H and Factory	43,275.2	2,280.3	IDR	16	35	53	72	90	109	129	150	170	190	210	232	254	275	297	319	341	364	386	409	432	455	478	501	524	547	570	593	616	640	663	663	663	663	663	663	663	663	663	663	663
3 Power Generation	142,976.3	14,365.8	IDR		47	94	1,586	1,586	1,588	1,588	1,588	1,588	1,588	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855
Total Economic Benefit	272,165.2	24,965.7	IDR	16	344	672	2,291	2,346	4,470	2,526	2,582	2,639	2,695	3,009	3,067	3,125	3,182	3,240	3,265	3,290	3,315	3,340	3,366	3,391	3,416	3,443	3,468	3,494	3,520	3,546	3,571	3,597	3,623	3,649	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653
Cash Flow	TOTAL	NPV	(Billion)																																									
CashFlow	157,394.8	-1,865.9	IDR	-3,649	-2,352	-2,032	-1,395	-2,212	738	1,602	1,656	1,710	1,553	973	1,261	1,240	1,366	571	289	1,107	1,126	1,146	913	862	1,156	-57	33	-770	-710	33	50	67	-198	-269	3,028	2,992	3,065	3,022	3,065	3,065	3,065	3,065	3,065	3,043	2,906
Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100		
1 Direct Cost Total			IDR																																									
2 Compensation,Engineering Service,Physical Contingency			IDR																																									
3 O&M			IDR	625	662	588	631	588	588	588	588	588	611	747	625	662	588	631	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	
Total Initial Cost (1~2)			IDR																																									
Total Cost (1~3)			IDR	625	662	588	631	588	588	588	588	588	611	747	625	662	588	631	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	
Economic Benefit			(Billion)																																									
1 Irrigation			IDR	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
2 Water Supply for H.H and Factory			IDR	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663
3 Power Generation			IDR	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855	1,855
Total Economic Benefit			IDR	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653	3,653
Cash Flow			(Billion)																																									
CashFlow			IDR	3,028	2,992	3,065	3,022	3,065	3,065	3,065	3,065	3,043	2,906	3,028	2,992	3,065	3,022	3,065	3,065	3,065	3,065	3,043	2,906	3,028	2,992	3,065	3,022	3,065	3,065	3,065	3,065	3,043	2,906	3,028	2,992	3,065	3,022	3,065	3,065	3,065	3,065	3,065	3,043	2,906

EIRR	8.6%
at Discount Rate of	10.0%
B/C	0.9

【Medium Scenario】All

	TOTAL	NPV	(Billion)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost																																												
1 Direct Cost Total	45,502.9	15,011.1	IDR	2,263	1,597	1,597	2,197	2,730	980	450	450	580	1,085	955	955	588	588	1,479	1,666	1,141	1,141	1,141	1,283	1,283	1,141	1,856	1,856	2,336	1,856	1,856	1,856	2,017	2,017											
2 Compensation,Engineering Service,Physical Contingency	28,052.6	9,254.3	IDR	1,395	985	985	1,355	1,683	604	277	277	277	358	669	588	588	588	912	1,027	703	703	703	791	791	703	1,144	1,144	1,440	1,440	1,145	1,145	1,145	1,243	1,243											
3 O&M	41,214.9	2,566.2	IDR	8	115	123	134	145	147	198	200	202	204	282	263	342	273	278	283	339	345	350	379	454	417	500	435	488	454	511	520	530	562	658	625	662	588	631	588	588	588	588	588	611	747
Total Initial Cost (1~2)	73,555.5	24,265.4	IDR	3,657	2,582	2,582	3,552	4,412	1,584	727	727	938	1,755	1,543	1,543	1,543	1,543	2,391	2,692	1,845	1,845	1,845	2,075	2,075	1,844	3,000	3,000	3,776	3,776	3,001	3,001	3,260	3,260	3,260											
Total Cost (1~3)	114,770.4	26,831.6	IDR	3,665	2,697	2,704	3,686	4,557	1,731	924	927	929	1,142	2,037	1,806	1,885	1,816	2,669	2,976	2,183	2,189	2,195	2,453	2,529	2,261	3,500	3,436	4,264	4,230	3,512	3,521	3,531	3,822	3,918	625	662	588	631	588	588	588	588	588	747
Economic Benefit	TOTAL	NPV	(Billion)																																									
1 Irrigation	93,783.7	9,088.1	IDR	0	300	600	715	750	846	881	916	951	986	1,024	1,059	1,094	1,129	1,165	1,174	1,177	1,180	1,183	1,187	1,190	1,193	1,203	1,206	1,209	1,212	1,215	1,218	1,221	1,224	1,227	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243
2 Water Supply for H.H and Factory	43,275.2	2,280.3	IDR	16	35	53	72	90	109	129	150	170	190	210	232	254	275	297	319	341	364	386	409	432	455	478	501	524	547	570	593	616	640	663	663	663	663	663	663	663	663	663	663	663
3 Power Generation	117,984.3	11,852.6	IDR		39	77	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309
Total Economic Benefit	255,043.2	23,221.0	IDR	17	374	731	2,096	2,150	2,264	2,320	2,375	2,430	2,486	2,766	2,822	2,879	2,936	2,993	3,024	3,050	3,075	3,101	3,127	3,152	3,178	3,211	3,237	3,263	3,289	3,316	3,342	3,368	3,395	3,421	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437
Cash Flow	TOTAL	NPV	(Billion)																																									
CashFlow	140,272.8	-3,610.6	IDR	-3,649	-2,322	-1,973	-1,890	-2,407	533	1,395	1,448	1,502	1,344	729	1,016	994	1,120	324	48	866	886	906	674	623	918	-289	-198	-1,000	-940	-196	-179	-162	-427	-497	2,812	2,776	2,849	2,806	2,849	2,849	2,849	2,849	2,849	2,826	2,690
Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100		
1 Direct Cost Total			IDR																																									
2 Compensation,Engineering Service,Physical Contingency			IDR																																									
3 O&M			IDR	625	662	588	631	588	588	588	588	588	611	747	625	662	588	631	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	
Total Initial Cost (1~2)			IDR																																									
Total Cost (1~3)			IDR	625	662	588	631	588	588	588	588	588	611	747	625	662	588	631	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	
Economic Benefit			(Billion)																																									
1 Irrigation			IDR	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243
2 Water Supply for H.H and Factory			IDR	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663
3 Power Generation			IDR	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531
Total Economic Benefit			IDR	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437	3,437
Cash Flow			(Billion)																																									
CashFlow			IDR	2,812	2,776	2,849	2,806	2,849	2,849	2,849	2,826	2,690	2,812	2,776	2,849	2,849	2,806	2,849	2,849	2,849	2,826	2,690	2,812	2,776	2,849	2,806	2,849	2,849	2,849	2,826	2,690	2,812	2,776	2,849	2,806	2,849	2,849	2,849	2,826	2,690				

EIRR	7.4%
at Discount Rate of	10.0%
B/C	0.9

【High Scenario】All

	TOTAL	NPV		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Economic Cost																																											
1 Direct Cost Total	45,502.9	15,011.1	IDR	2,263	1,597	1,597	2,197	2,730	980	450	450	450	580	1,085	955	955	588	912	1,479	1,666	1,141	1,141	703	703	791	791	1,141	1,856	1,856	2,336	2,336	1,856	1,856	2,017	2,017	1,243								
Compensation,Engineering Service,Physical Contingency	28,052.6	9,254.3	IDR	1,395	985	985	1,355	1,683	604	277	277	277	358	669	588	588	588	588	912	1,027	703	703	703	703	791	791	1,144	1,144	1,144	1,440	1,440	1,145	1,145	1,145	1,243	1,243								
2 O&M	41,214.9	2,566.2	IDR	8	115	123	134	145	147	198	200	202	204	282	263	263	342	273	278	283	339	345	350	379	454	417	500	435	488	454	511	520	530	562	658	625	662	588	631	588	588	588	611	747
Total Initial Cost (1 ~ 2)	73,555.5	24,265.4	IDR	3,657	2,582	2,582	3,552	4,412	1,584	727	727	727	938	1,755	1,543	1,543	1,543	2,391	2,692	1,845	1,845	1,845	1,845	2,075	2,075	1,844	3,000	3,000	3,776	3,776	3,001	3,001	3,360	3,260									
Total Cost (1 ~ 3)	114,770.4	26,831.6	IDR	3,665	2,697	2,704	3,686	4,557	1,731	924	927	929	1,142	2,037	1,806	1,885	1,816	2,669	2,976	2,183	2,189	2,195	2,453	2,529	2,261	3,500	3,436	4,264	4,230	3,512	3,521	3,531	3,822	3,918	625	662	588	631	588	588	588	611	747
Economic Benefit	TOTAL	NPV	(Billion)																																								
1 Irrigation	103,378.0	9,788.8	IDR		274	548	689	732	926	969	1,012	1,054	1,097	1,135	1,177	1,220	1,263	1,306	1,315	1,317	1,320	1,323	1,325	1,328	1,331	1,339	1,342	1,345	1,347	1,350	1,353	1,355	1,358	1,361	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371
2 Water Supply for HH and Factory	43,275.2	2,280.3	IDR	16	35	53	72	90	109	129	150	170	190	210	232	254	275	297	319	341	364	386	409	432	455	478	501	524	547	570	593	616	640	663	663	663	663	663	663	663	663	663	663	663
3 Power Generation	106,710.4	10,712.3	IDR		35	70	1,182	1,182	1,182	1,182	1,182	1,182	1,182	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385
Total Economic Benefit	253,363.6	22,781.5	IDR	16	344	671	1,943	2,004	2,217	2,280	2,343	2,406	2,469	2,730	2,795	2,859	2,923	2,988	3,018	3,043	3,069	3,094	3,119	3,145	3,170	3,202	3,227	3,253	3,279	3,305	3,331	3,357	3,383	3,409	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419
Cash Flow	TOTAL	NPV	(Billion)																																								
Cashflow	138,593.2	-4,050.1	IDR	-3,649	-2,353	-2,033	-1,743	-2,553	486	1,356	1,417	1,478	1,327	693	988	974	1,107	319	42	860	880	899	666	616	910	-298	-208	-1,011	-951	-207	-191	-174	-439	-509	2,795	2,758	2,831	2,831	2,831	2,831	2,831	2,809	2,673
Economic Cost			(Billion)	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	
1 Direct Cost Total			IDR																																								
Compensation,Engineering Service,Physical Contingency			IDR																																								
3 O&M			IDR	625	662	588	631	588	588	588	588	588	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	
Total Initial Cost (1 ~ 2)			IDR																																								
Total Cost (1 ~ 3)			IDR	625	662	588	631	588	588	588	588	588	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	625	662	588	631	588	588	588	588	611	747	
Economic Benefit			(Billion)																																								
1 Irrigation			IDR	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371	1,371
2 Water Supply for HH and Factory			IDR	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663	663
3 Power Generation			IDR	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385
Total Economic Benefit			IDR	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419	3,419
Cash Flow			(Billion)																																									
Cashflow			IDR	2,795	2,758	2,831	2,788	2,831	2,831	2,831	2,831	2,809	2,673	2,795	2,758	2,831	2,788	2,831	2,831	2,831	2,831	2,809	2,673	2,795	2,758	2,831	2,788	2,831	2,831	2,831	2,831	2,809	2,673	2,795	2,758	2,831	2,788	2,831	2,831	2,831	2,831	2,809	2,673	

EIRR	7.1%
at Discount Rate of	10.0%
B/C	0.8