Part I Master Plan Study

Tables

Table 1.5.2 List of Advisory Committee

Position	Name	Agency
Chairman	Josuke KASHIWAI	Leader of Dam Hydraulic Engineering Research Team, Hydraulic Engineering Research Group, Incorporated Administrative Agency, Public Works Research Institute under the Ministry of Land, Infrastructure and Transport
Member	Takashi HOSODA	Professor of River System Engineering, Department of Urban Management, Faculty of Engineering, Kyoto University
Member	Hitoshi NOGUCHI	Head of Fluid Mechanics Division, Construction and Control Systems Department, Port and Airport Research Institute under the Ministry of Land, Infrastructure and Transport
Member	Junji YOKOKURA	Senior Technical Advisor for Overseas Activities, Overseas Activities Department, Japan Green Resources Agency

Source: JICA Study Team

Table 1.5.3 List of Experts

No.	Position	Name
1	Team Leader/Reservoir Sedimentation/Dam Operation Planner	Minoru OUCHI
2	Co-Team Leader/Watershed Management/Soil Erosion Expert	Kenjiro ONAKA
3	Hydrologist	Naoki YAMASHITA
4	Civil Engineer/Sediment Removal System	Hidetoshi KANAMURA
5	Sediment Hydraulic Expert	Tadahiro FUKUDA
6	Hydraulic Numerical Analyst	Haisheng JIN
7	Topographic Survey Expert	Yutaka NAKADA
8	GIS Expert	Masahiko TANIGUCHI
9	Geologist	Yasushi MOMOSE
10	Social Investigation/Community Empowerment Expert	Tetsunari GEJO
11	Environmentalist	Hitoshi SAKAI
12	Civil Engineer/Dam & Related Facility	Tamotsu SHINGU
13	Agriculture/Soil Expert	Takashi SHIRAKI
14	Cost Estimator/Construction Planner	Masaru TOKUNO / Kozo YAMADA
15	Institution/Laws and Regulations Expert	John A.L. CHETTOE
16	Socio-economist	Magdalena LUKOWSKA
17	Coordinator/Water Quality Expert	Hikaru SUGIMOTO

Source: JICA Study Team

Table 1.5.4 List of Counterpart Personnel

No.	Name	Position	Agency	1st	2nd
1	Ir. Tri Rohadi, Dipl HE	Chief Counterpart 1/Reservoir Sedimentation	IPKPWSBS	O	O
2	Ir. Hetomo, Dipl HE	Chief Counterpart 2/Reservoir Sedimentation	IPKPWSBS	–	O
3	Ir. Erwin Budoyo, M.Eng	Dam Operation Planner	PJT I B.Solo	O	O
4	Ir. Widihardjo, Sp	Watershed Management/Soil Erosion Expert	IPKPWSBS	O	O
5	Drs. Setyo Susilo	Watershed Management Expert	Dinas LHKP Kab Wonogiri	O	O
6	Rejodadi	Soil Erosion Expert	Dinas LHKP Kab Wonogiri	–	O
7	Suparno	Hydrologist	IPKPWSBS	O	O
8	Ir. Mulyana, Sp.1	Civil Engineer/Sediment Removal System	PJT I B.Solo	–	O
9	Ir. Lilik Retno C, MA	Sediment Hydraulic Expert	IPKPWSBS	O	O
10	Ir. Sriyanto	Sediment Hydraulic	PJT I B.Solo	O	–
11	Ir. Daryanto	Sediment Survey	IPKPWSBS	O	–
12	Ir. Wisman Hari Ismoyo	Topographic Survey	IPKPWSBS	O	–
13	Pardjo, BE	Topographic Survey	IPKPWSBS	O	–
14	Ir. Raden Dody Prakoso	GIS Expert	BP2TPDAS IBB	O	O
15	A. Supriyanto, SP	GIS Expert	BPDAS Solo	O	O
16	Sudarmadji, SST	Geologist	IPKPWSBS	O	O
17	Hernowo Edy Yuliasto	Geologist	IPKPWSBS	O	–
18	Ir. Edi Djoko Dwiono	Social Investigation/ Community Empowerment Expert	Bappeda Kab. Wonogiri	O	O
19	T. Sarwono, BE	Social Investigation/ Community Empowerment Expert	IPKPWSBS	O	–
20	Ruwiyo Sudjatmiko, S Sos	Environmentalist	IPKPWSBS	O	O
21	Ir. S.B. Ekoyanto	Civil Engineer/Sediment Removal System	IPKPWSBS	O	–
22	Ir. Wuryanto A Sidik, Sp.1	Civil Engineer/Dam & Related Facility	IPKPWSBS	–	O
23	Ir. Muljana, SP	Civil Engineer/ Dam & Related Facility	PJT I B.Solo	O	–
24	Ir. Sri Widowati	Agriculture/Soil Expert	Dipertanbun Kab. Wonogiri	O	O
25	Ir. Saksono	Agriculture/Soil Expert	IPKPWSBS	O	–
26	Gemala Suzanti, SP. MMA	Agriculture/Soil Expert	IPKPWSBS	–	O
27	Joko Inti, ST. MT	Cost Estimator/Construction Planner	SKS PPSABS	–	O
28	Ir. Suyatmo	Cost Estimate	IPKPWSBS	O	–
29	Bsimo Sustyo, SST	Construction Plam	PJT I B.Solo	O	–
30	Supriyanto, ST	Institution/Laws and Regulation Expert	SKS PPSABS	–	O
31	Wiyanto, SH	Institution/Laws and Regulation Expert	Bag.Hukum Setkab Wonogiri	–	O
32	Ir. Tugiyo	Socio Economist	Bappeda Kab. Wonogiri	O	O
33	Dwi Sularjanto, BE	Water Quality Expert	IPKPWSBS	O	O
34	Drs. Djoko Widodo, MT	Water Quality Expert	PJT I B.Solo	O	–

Note: The 1st field works : August 2004 – February 2005
The 2nd field works : May 2005 – March 2006

Source: JICA Study Team

Table 2.1.1 Socio-Economic Indicators of the Study Area

	Indonesia		Central Java Prov.		Wonogiri watershed area		Wonogiri irrigated area							
					kab. Wonogiri		kab. Karanganyar		kab. Sukoharjo		kab. Klaten		kab. Sragen	
	1999	2002	1999	2002	1999	2002	1999	2002	1999	2002	1999	2002	1999	2002
Life Expectancy	66.2	66.2	68.3	68.8	71.1	71.6	70.1	71.8	69.1	69.3	69.1	69.8	70.8	71.5
Adult Literacy Rate	88.4	89.5	84.8	85.7	76.4	77.4	78.3	78.9	84.0	82.2	81.1	82.8	71.6	75.3
Mean Year of Schooling	6.7	7.1	6.0	6.5	5.6	5.9	6.1	7.0	7.4	7.9	6.7	7.3	5.3	6.0
Adjusted Real per capita Expenditure [Rp. 000]	578.8	591.2	583.8	594.2	584.2	607.6	587.6	617.1	591.8	607.0	589.0	607.3	581.3	592.7
HDI	64.3	65.8	64.6	66.3	64.0	66.5	64.5	68.5	66.5	67.7	65.1	67.8	62.3	64.9
Population with No Access to Fresh Water [%]	51.9	44.8	47.8	39.8	41.3	38.0	58.3	31.4	64.8	40.0	54.7	49.5	40.9	39.6
Population with No Access to Health Facilities [%]	21.6	23.1	17.1	20.9	25.9	16.8	17.1	23.9	17.1	14.0	17.1	13.9	51.3	36.0
HH with No Access to Sanitation [%]		25.0	30.9	31.1	7.1	10.3	35.0	29.0	25.4	17.1	36.2	37.2	24.7	23.1
Open Unemployment [%]		10.6		8.1		5.4		5.3		6.9		7.0		9.6
Employment in Informal Sector [%]		64.1		66.6		78.2		63.9		57.4		63.2		69.0
GRDP Real per capita 2000 [Rp. 000]														
with oil & gas				1,340		788		1,542		1,480		1,069		807
without oil & gas				1,201		788		1,542		1,480		1,069		807
Annual Growth in Real GRDP per capita														
1999/2000 Annual Growth/ with oil & gas			1.1	2.9	1.4	3.0	1.7	3.3	0.0	2.2	0.0	3.5	1.4	2.2
1999/2000 Annual Growth/ without oil & gas			0.9	2.5	1.4	3.0	1.7	3.3	0.0	2.2	0.0	3.5	1.4	2.2
Average Non-Agriculture Wage [Rp. 000]														
Average Non-Agriculture Wage Female [Rp. 000]	461.8		186.7	313.1	217.9	336.0	150.7	342.1	214.0	349.5	191.1	289.9	169.1	279.3
Average Non-Agriculture Wage Male [Rp. 000]	680.7		294.7	500.0	297.1	484.3	270.1	590.1	294.7	529.6	273.4	432.3	274.0	476.8
Per Capita Expenditure [Rp.000]		206.3		156.0		149.0		181.0		183.0		161.0		142.0
Food [% of total expenditure]		58.5		61.0		62.7		57.2		56.5		60.7		63.8
Poverty Line [Rp./capita/month]		109,000		106,438		102,932		107,583		105,071		104,347		95,302
Number of Poor People [thousand]		38,394		7,308		246		134		135		287		245
Poverty Rate [%]		18.2		23.1		25.2		17.0		16.9		24.5		28.6
HPI	25.2	22.7	23.2	21.0	23.0	20.9	26.0	19.4	24.3	19.7	24.1	20.9	31.1	24.8

Source: Susenas 2002; BPS; Indonesia: Human Development Report 2004 for HDI; Wonogiri in Figures 2004, Central Java in Figures 2004

Table 2.4.1 Soil Distribution in Wonogiri Catchment Area

Sub-DAS	Soil Type								Total	
	Mediteran (Alfisols)		Litosol (Inceptisols)		Grumsol (Vertisols)		Latosol (Alfisols)			
	ha	%	ha	%	ha	%		%	Ha	%
Keduang	17,789	42	9,487	23			14,861	35	42,137	100
Tirtomoyo	6,951	33	9,052	43	5,085	24			21,088	100
Temon	3,639	58			2,631	42			6,270	100
Upper Solo	14,161	72	2,675	14	2,878	15			19,714	100
Alang	6,150	36	5,666	33	5,152	30			16,968	100
Wuryantro	980	14	1,938	27	4,262	59			7,180	100
Ngunggahan	2,663	32	2,252	27	3,349	41			8,264	100
Residual Basin	128	4			2,734	96			2,862	100
Land Area Total	52,461	42	31,070	25	26,091	21	14,861	12	124,483	100
Water Surface									8,767	
Total	52,461	-	31,070	-	26,091	-	14,861	-	133,250	-
Marent Materials	Volcanic tuff		Volcanic tuff Limestone		Volcanic tuff Clay deposit		Volcanic tuff			
Physiography	Volcanic slope Volcanic piedmont		Volcanic slope Fold & uplift		Flat or fold Volcanic slope		Volcanic slope			

Source: Soil maps prepared by Sub Balai Rehabilitasi Lahan dan Konservasi Tanah, Solo, 1985; based on a map prepared by Soil Research Institute, Bogor, 1973

Table 8.6.1 Evaluation of Alternatives for Countermeasures for Sediment Deposits and Garbage at Intake

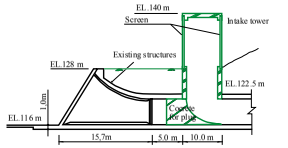
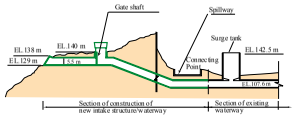
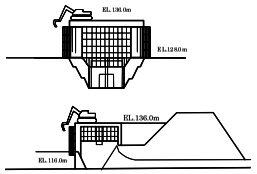
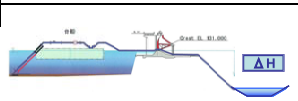
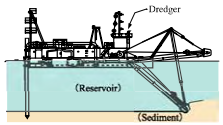
Alternatives		Feature	Facility Plan	Cost	Evaluation
1) Modification of intake		◆Intake tower with selective intake gate is to be constructed on the existing intake to raise foundation height of Inlet. ◆This method aims at avoiding the intake from being buried by sedimentation and to prevent garbage from entering the inlet.	i) Intake Tower Height H=26.0 m Gates H5.0m x B12.6m x 2nos. Elevation of bottom of inlet EL.127.0 m	i) Construction Cost $3,160,000 ii) O&M Cost $53,000/year	◆ Water supply should be suspended during construction. ◆ Strong load bearing capacity of foundation shall be needed to support the superstructure. ◆ Sedimentation would be accelerated due to heightening of inlet foundation from EL.116.0 m to 127.0 m.
2) Relocation of intake		◆Relocation of the existing intake to 300m upstream on the left bank where less sedimentation is expected ◆Intake tower with selective intake with gates is to be constructed. ◆Waterway tunnel is constructed to connect the existing conduit to the power station.	i) Intake Tower Height H=26.0 m Gates H5.0m x B12.6m x 2nos. Elevation of bottom of inlet EL.127.0 m ii) Transmission Tunnel Diameter D=5.5 m Length L=570 m	i) Construction Cost $8,800,000 ii) O&M Cost $140,000/year	◆Construction cost is the highest ◆ Sedimentation has already been occurred around the proposed site. So effectiveness and reliability against sedimentation is very low. ◆ Water supply should be suspended during connection work with the existing conduit.
3) Garbage trapping structure at intake		◆Overflow weir is to be constructed around the existing intake. ◆Trash racks are to be installed on the overflow weir to block garbage entering into the intake. ◆Approaching deck is to be installed over the trash racks to connect the dam crest and this structure. These deck and trash rack are designed to be submergible to minimize construction cost. ◆Garbage on trash rack shall be removed by back hoe to minimize maintenance works.	i) Double Screen H26.0m x L111.2m Area A=890 m^2 ii) Approach Deck Length L=106 m Width B=7.0 m Area A=740 m^2 iii) Steel Pile Φ1,000 mm x H9.0 m x 34 nos.	i) Construction Cost $3,670,000 ii) O&M Cost $65,000/year	◆Garbage removal work become easy by this method. ◆Water supply should be suspended during construction. ◆ Certainty and effectiveness are very high among countermeasures.
4) Dredging by Hydro-suction method		◆Hydro-suction system is to be installed to remove the sediment and garbage at intake.	i) Hydro-suction system	i) Construction Cost $2,875,000 ii) O&M Cost $99,000/year	◆This method is considered to reduce operational cost with normal hydraulic dredging. ◆Certainty of this method is a little inferior to hydraulic dredging, however effectiveness of this method for both sediment and garbage were confirmed. ◆There are operational constraints depending on the reservoir water levels.
5) Hydraulic dredging		◆Remove the sediment and garbage at intake by pump dredger.	i) Dredger Suction dredger, 600PS x 1unit	i) Construction Cost $4,456,700 ii) O&M Cost $320,200/year	◆This method is common countermeasure against reservoir sedimentation. ◆Reliability of sediment removing performance is highest among the alternative countermeasures. ◆Running cost is highest. And spoil bank is required.
6) Garbage trapping structure in the Keduang River		◆Overflow weir with steel pipes is to be constructed on the Keduang River before entering the reservoir. ◆Sabo dam with steel-pipe type trapping structure is common in Japan to trap and remove garbage. ◆Garbage removal works will be carried out periodically.	i) Concrete Weir Dam width W=56.3 m Dam height H= 9.3 m Design discharge Q= 1,370 m^3/s Crest width Bc= 70 m Overflow depth Hw=4.9m ii) Steel material Width B=25.0 m Height H=4.0 m	i) Construction Cost $1,370,000 ii) O&M Cost $21,000/year	◆This method is to reduce garbage entering into the reservoir. ◆Periodical garbage removal works are needed.

Table 8.6.2 Evaluation of Alternatives for Countermeasures for Sediment Inflow from Keduang River

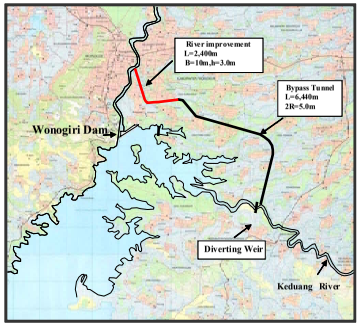
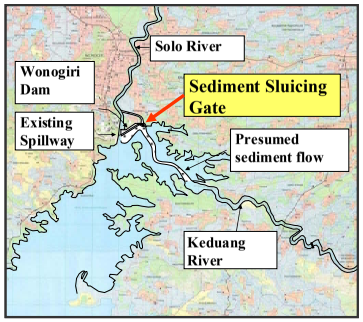
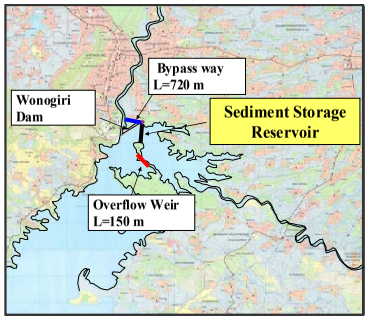
Alternatives		Feature and Sediment Balance	Facility Plan	Cost	Evaluation
1) Keduang River Sediment bypass		◆This method is reduce the sediment inflow from the Keduang River into the reservoir by diverting the sediment inflow with high concentration into the bypass tunnel to the downstream river. ◆Target sediment is the wash loads because tractive force is small due to gentle bypass tunnel (channel) gradient of 1/1,000 . ◆This method is usually effective in case that it would be difficult to lower the water level for sediment flushing and the reservoir is relatively small. ◆Efficiency of Sediment Removal Volume 757,000 m^3 (wet year) Concentration 2,789 ppm (wet year) * wet year 1998-1999	i) Bypass tunnel L = 6,435 m, I = 1/1,000 Horseshoe section 2r = 5.0 m Design discharge Q = 50 m3/s ii) River improvement L=2,395m, I=1/200 Cross section B10.0 m x H3.0 m (side slope 1:0.5) Design discharge Q = 65 m^3/s iii) Diverting Weir W=137.9 m, H= 9.3 m, Design discharge Q = 1,370 m^3/s Crest width Bc = 70 m Overflow depth Hw =4.9 m Gates H6.7m x B5.0m x 2nos.	i) Construction Cost $82,940,000 ii) O&M Cost $1,597,000/year iii) Unit cost $10.7/$m^3$	◆Construction cost and O&M cost will be highest among the alternative countermeasures. ◆Volume of sediment released is almost the same with other alternatives, however reliability and effectiveness of sediment releasing is high. ◆Length of bypass channel is very long. And compensation for land acquisition will be necessary.
2) Sediment sluicing by new gates		◆This method is to path through incoming flood inflow from the Keduang River with high turbidity to the downstream reaches through new gate before deposition in the reservoir. ◆New sluicing gate is to be installed on the right abutment of the dam to make the Keduang flood inflow smoothly flowing into sluice gate. ◆Efficiency of Sediment Removal Volume 843,000 m^3 (wet year) Concentration 2,712 ppm (wet year) * wet year 1998-1999	i) Sediment gate Hl2.6 m x B5.0 m x 4nos. ii) Spillway channel L = 723 m, B = 20 m iii) Fore bay excavation Level of excavation EL.127.0 m Volume 183,000 m^3	i) Construction Cost $35,630,000 ii) O&M Cost $672,000/year iii) Unit cost $4.7/$m^3$	◆Facilities required are only sluicing gate and chute way which can be constructed within the dam area, so no need for land acquisition. ◆Construction cost is cheapest among the alternatives, it is around 1/2 of the sediment bypassing. ◆Effectiveness of sediment release is almost the same as the sediment bypassing. ◆Sediment sluicing is only effective when the reservoir water level is low mainly in the beginning of the wet season. When the reservoir water level is high, efficiency on sediment releasing becomes small.
3) Sediment storage reservoir with new gates in reservoir		◆This method is to create a small sediment storage reservoir for the sediment inflow from the Keduang River inside the reservoir. ◆The small sediment storage reservoir is created by installation of closure dike. ◆New gate is to be installed for sediment releasing on the same location of the sediment sluicing alternative. ◆Because of small capacity of sediment storage reservoir, the reservoir water level rises rapidly due to inflow from the Keduang River. The stored water in the storage reservoir is diverted into the main reservoir through the new overflow weir. ◆Efficiency of Sediment Removal Volume 1,380,000 m^3 (wet year)	i) Closure dike : double sheet pile L = 650 m, H = 15 m, B = 10 m ii) Sediment gate Hl2.6 m x B7.5 m x 4nos. iii) Spillway channel L = 723 m, B = 20 m iv) Fore bay excavation Level of excavation EL.127.0 m Volume 183,000m^3 v) Overflow weir L = 150 m, B = 10 m	i) Construction Cost $47,090,000 ii) O&M Cost $908,000/year iii) Unit cost $3.8/$m^3$	◆Sediment storage reservoir can be operated separately from the main Wonogiri reservoir. ◆ Sediment flushing can be operated without lowering main reservoir water level. ◆All facilities can be constructed within dam site area without land acquisition. ◆Garbage issues at intake will be solved because almost all of the garbage from the Keduang River is retained in the storage reservoir. ◆Sediment flushing can be made after storing water up to NHWL in the main reservoir. ◆As well as sediment flushing, sediment sluicing can be made in the beginning of the wet season. ◆Sustainability, reliability and effectiveness of sediment releasing are highest among the alternative countermeasures.

Table 8.6.3 Evaluation of Alternatives for Countermeasures for Sediment Inflow from Other Tributaries

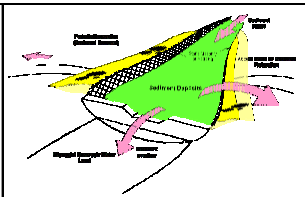
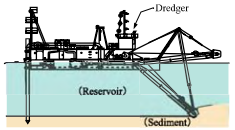
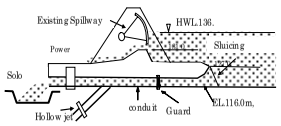
Alternatives		Feature	Facility Plan	Cost	Evaluation
1) Sediment storage dam for sediment removal (Check dam, Sabo dam)		◆ Sediment storage dams are constructed on the river channel of major tributaries to trap and store sediments, and to remove by excavation. ◆Removal works of sediment deposits is carried out in the dry season ◆Trapped sediments shall be periodically removed by excavation by back hoe and conveyed to spoil banks by trucks. ◆Relatively coarse sediments are deposited in the storage dam and finer sediments flow into the reservoir	i) Sediment Storage Dam x 83units Dam width W = 116 m Dam height H = 9.3 m Storage Capacity V = 24,000 m^3 Crest width Bc = 70 m Overflow depth Hw = 5.0 m	i) Construction Cost $225,460,000 ii) O&M Cost $3,189,000/year iii) Unit cost $12.8/$m^3$	◆This method is common to trap sediments in river . Many check dams have been already constructed. However these dams have been already filled with sediments without excavation. ◆As the target sediment is wash loads, sediment trapping ratio will be very small. ◆Further, trapping capacity of storage dam is very small comparing the sediment inflow, so many storage dams shall be constructed to cope with sediment inflow. ◆ Due to limitation of locations of storage dam, trapped sediments in the storage dam shall be removed by excavation. Thus huge spoil bank areas shall be required.
2) Hydraulic dredging in reservoir		◆This method is to remove the deposited sediment in the reservoir by hydraulic dredging. ◆Dredged sediments shall be conveyed to spoil banks.	i) Dredger Suction dredger, 600PS x 10 units	i) Construction Cost $44,567,000 ii) O&M Cost $3,202,000/year iii) Unit cost $4.3/$m^3$	◆ Huge spoil bank areas shall be required. ◆ Running cost is very expensive. ◆ Reliability of sediment removal is high.
3) Dry excavation in reservoir		◆Dry excavation in the reservoir shall be carried out by back hoe or crawler-mounted bulldozer for swamp in the dry season when deposited sediments appear on the ground near the river mouths of major tributaries in the reservoir. ◆Excavated sediments shall be conveyed to spoil banks by trucks.	i) Bulldozer 4t, swamp x 2,960 units ii) Crawler loader, 2.3 m3 x 40unit iii) Dump truck, 20 ton x 165 units	i) Construction Cost $287,990,000 ii) O&M Cost $7,754,000/year iii) Unit cost $19.0/$m^3$	◆Reliability of this method is high. ◆This method is apply for sediment removal in sediment storage dam, however, to cope with all sediments deposited in the reservoir (around 20,000 m3/day) by sole dry excavation, many systems are required, consequently cost must be very high. ◆ Huge spoil bank areas shall be required.
4) Managing of sediments within reservoir by water releasing from the intake		◆This method aims at moving the previously deposited sediments toward the dead zone of the reservoir, thereby maintaining or increasing the effective capacity of the reservoir. ◆At the beginning of wet season, the maximum intake discharge (70 m3/s) shall be released continuously for long duration, say 2 months. ◆This method is categorized as sediment sluicing by use of the existing intake.	No new facilities might be necessary. Maintenance of the existing intake shall be necessary.	i) Construction Cost $0 ii) O&M Cost $0/year iii) Unit cost $ 0/m^3	◆ Reliability of this method is very low without countermeasure for blocking of intake due to garbage. Garbage removal system is st the intake will be indispensable. ◆ This method has been functioned at normal operation, however it can not be a solution to cope with massive sediment inflow into dam reservoir. ◆Significant amount of water shall be released and thus there is a risk that the reservoir water level can not reach NHWL.

Table 9.1.1 Lessons Learned from Past Experiences in Watershed Conservation Projects in DAS Wonogiri

1. Technical Issues

- Well integrated & coordinated physical and vegetative or civil and agricultural measures are
- Combined package of conservation measures and improved agricultural practices must provide adequate and immediate & long term financial gains to farmers for ensuring positive participation of
- Introduction of measures which are accepted & practiced by farmers/farmers groups and sustainable; not sophisticated, low cost, use of available materials.
- Agro-forestry approaches: Past projects were too much forestry oriented; to employ integrated forestry & agronomic approaches.
- Not blue print approaches, but area specific & flexible prescriptions by watershed conditions are
- High priority to be given to sub-watersheds which are main contributors to the acute sedimentation problems in the Wonogiri Reservoir.
- Land is often left by the family head working on a seasonal basis in the cities. Recommended agricultural measures are to be in line with this reality.
- Crop Selection & Cropping Pattern
  - Need of crops tolerant to dry climate & with adequate economic value
  - Introduction of area specific superior crops/commodity andalan for dry land
  - Further adaptation of multiple cropping system with legumes should be aimed for improvement of
  - Development of commodities suitable for conservation purposes is to be envisaged.
  - Selection of agricultural commodities should be based on market potential followed by technical &
  - One alternative is to combine perennial crops with seasonal crops in home compound & dry farm

2. Project Management Issues

- Project failed because of top-down management & use of inflexible prescriptions poorly adapted to loc
- Reasons not following integrated approaches; project expenditures are to be spread as much as possible among villages and communities in the project area.
- Planning is to be based on prospects for sustainable income flow, farmers traditional customs of cultivation, off-farm income, availability of credits & markets, existing social priorities.
- Grant aid in terrace rehabilitation has resulted in a detrimental change in social behavior in self reliant activities for soil conservation and terrace rehabilitation.
- Depending solely on conservation measures would mean implementing remedial measures without tackling, preventing and solving the real causes.
- Monitoring of performances of the programs implemented seldom practiced in the past.
- Precondition for success: strong & motivated extension services involving PPL & PKL will form the key in implementing & sustaining conservation efforts.
- Government support is still required & essential for supporting farming activities. The level of incentives should be sufficiently high to induce farmers participation in soil conservation programs.
- Legal or official procedures will be necessary for controlling cropping pattern in dry farm land.

3. Social & Institutional Issues

- Institutionalization of integrated & synergetic efforts & activities toward watershed management in the Wonogiri catchment area is to be envisaged.
- Technical collaboration team & technical working team at kabupaten level and integrated
- institutions at kecamatan & village levels are to be established.
- Multi-stakeholders dialog at district & watershed levels are to be maintained.
- As farmers are becoming more interested in income earned in non-agricultural activities, they are increasingly reluctant to invest in their own farm especially when it concerns maintenance of their
- To achieve a balance between the farmers aspiration & the project objectives, an integrated planning which involves the bottom-up and bottom-down approaches is needed.
- Peoples behavior depends on their local culture. So, whatever programs must be formulated accordingly and not given as a uniform package for all locations, but must be arranged together with their leaders and then given to the people by various methods of extension and communications. Traditional values must be taken into account to ensure participation of communities.

1/: Lessons learned was extracted based on the review on the following reports & interview with the agencies concerne

- Consulting Services for the Upper Solo (Wonogiri) Watershed Protection Project, Monitoring & Evaluation Final Report, July 1991, BCEOM
- Report on the Evaluation of Wonogiri Watershed Management, Watershed Management Technology Center (BP2TP DAS), Surakarta, 1995

Table 9.3.8 Basic Countermeasurs for Watershed Conservation in the Wonogiri Catchment Area (1/2)

Subject Area	Slope Class	Terrace Type & Condition	Land Unit	Soil & Water Conservation Measures			Support Programs Required
				Physical Measures	Vegetative Measures/Agro-forestry Target Place/Vegetative Measures/Agro-forestry	Vegetation 1/	
Upland Field with Bench Terrace	All Classes	Good Quality Bench Terrace	**U S 1 ~ 4 T 1**	**No conservation works planned**	1. Terrace Bench (cultivated area) (1) Agro-forestry & Land Use Modification 1) Slope Class: 0 - 8 % **Annual crops 90% + Tree crops/trees 10%** 2) Slope Class: 0 - 15 % **Annual crops 25% + Tree crops/trees 25%** 3) Slope Class: >15 - 25 % **Annual crops 50% + Tree crops/trees 50%** 4) Slope Class: >25 - 40 % **Land use conversion to orchard** **Tree crops/trees 75% + Annual crops 25%** 5) Slope Class: >40 % **Land use conversion to orchard/forest** **Tree crops/trees 100%**	Annual Crops + Tree Crops/Tree Annual Crops + Tree Crops/Tree Annual Crops + Tree Crops/Tree (+ medical crops) Tree Crops/Trees + Annual Crops (+ medical crops) Tree Crops/Trees (+ medical crops + Cover Crop/Grasses)	Provision of: - Agro-forestry Development ・Tree crop/tree seedling ・Fertilizer/compost ・Labor cost (incentives) Extension Services: ・Formation/empowerment of farmer groups ・Training program ・Field programs ・Livestock support program
		Medium & Fair to Poor Quality Bench Terrace	**U S 1 ~ 5 T 2 ~ 3**	**1. Bench Terrace Improvement Works** 1-1. Terrace Lip Improvement (1) Terrace Lip Improvement - Forming or reshaping & strengthening of terrace lip like ridge of paddy field 1-2. Terrace Riser Improvement (1) Terrace Riser Improvement - Forming or reshaping of terrace riser - Preventing reshaping or clearing practices of riser & preserving vegetation 1-3. Terrace Bench Improvement (1) Terrace Bench Reformation 1) Bench improvement & construction of terrace drain - Backward slopping of terrace bench; constriction of terrace drain and excavation of dugout for water & sediment deposition 1-4. Waterway & Drop Structure Improvement 1) Improvement of waterway & drop structure	1. Terrace Lip (1) Terrace Lip Stabilization 1) Vegetating lip with grasses or shrubs with economic use (fodder, fuel) 2) Preventing planting of cassava on lip 2. Terrace Riser (1) Terrace Riser Stabilization 1) Vegetating riser with grasses of creeping nature 2) Preventing planting of cassava on riser 3. Terrace Bench (cultivated area) (1) Agro-forestry & Land Use Modification 1) Slope Class: 0 - 8 % **Annual crops 90% + Tree crops/trees 10%** 2) Slope Class: 0 - 15 % **Annual crops 25% + Tree crops/trees 25%** 3) Slope Class: >15 - 25 % **Annual crops 50% + Tree crops/trees 50%** 4) Slope Class: >25 - 40 % **Land use conversion to orchard** **Tree crops/trees 75% + Annual crops 25%** 5) Slope Class: >40 % **Land use conversion to orchard/forest** **Tree crops/trees 100%**	Grasses - Elephant grass - R. Kolonjono - *Brachyaria brizantha* Shrubs - *Leucaena leucocephala (lamtoro)* - *Glyricideae* Grasses (Creeping/runner type grasses preferable) - *Brachyaria brizantha (BB)* - *Brachiaria decumbens (BD)* - Local grass (ebalan rumput) Annual Crops + Tree Crops/Tree Annual Crops + Tree Crops/Tree Annual Crops + Tree Crops/Tree (+ medical crops) Tree Crops/Trees + Annual Crops (+ medical crops) Tree Crops/Trees (+ medical crops + Cover Crop/Grasses)	Provision of: - Agro-forestry Development ・Tree crop/tree seedling ・Fertilizer/compost ・Labor cost (incentives) - Farming support ・Soil ameliorant ・Farm inputs Extension Services: ・Formation/empowerment of farmer groups ・Training program ・Field programs ・Livestock support program

Table 9.3.8 Basic Countermeasurs for Watershed Conservation in the Wonogiri Catchment Area (2/2)

Subject Area	Slope Class	Terrace Type & Condition	Land Unit	Soil & Water Conservation Measures			Support Programs Required
				Physical Measures	Vegetative Measures/Agro-forestry Target Place/Vegetative Measures/Agro-forestry	Vegetation 1/	
Upland Field without Bench Terrace, Traditional Terrace & Settlement Area under upland Field Condition	All Classes	Composite	**P S 1 ~ S 5 T 4**	**2. Terrace Formation/Upgrading Works**			
				2-1. Construction of bench terrace 1) Upgrading current terraces into improved bench terrace or formation of improved bench terrace 2-2. Waterway & Drop Structure Construction 1) Construction of waterway & drop structure	1. Terrace Lip (1) Terrace Lip Stabilization 1) Vegetating lip with grasses or shrubs with economic use (fodder, fuel) 2) Preventing planting of cassava on lip 2. Terrace Riser (1) Terrace Riser Stabilization 1) Vegetating riser with grasses of creeping nature 2) Preventing planting of cassava on riser 3. Terrace Bench (cultivated area) (1) Agro-forestry & Land Use Modification 1) Slope Class: 0 - 8 % **Annual crops 90% + Tree crops/trees 10%** 2) Slope Class: 0 - 15 % **Annual crops 25% + Tree crops/trees 25%** 3) Slope Class: >15 - 25 % **Annual crops 50% + Tree crops/trees 50%** 4) Slope Class: >25 - 40 % **Land use conversion to orchard** **Tree crops/trees 75% + Annual crops 25%** 5) Slope Class: >40 % **Land use conversion to orchard/forest** **Tree crops/trees 100%**	Grasses - Elephant grass - R. Kolonjono - *Brachyaria brizantha* Shrubs - *Leucaena leucocephala (lamtoro)* - *Glyricideae* Grasses (Creeping/runner type grasses preferable) - *Brachyaria brizantha (BB)* - *Brachiaria decumbens (BD)* - Local grass (ebalan rumput) Annual Crops + Tree Crops/Tree Annual Crops + Tree Crops/Tree Annual Crops + Tree Crops/Tree (+ medical crops) Tree Crops/Trees + Annual Crops (+ medical crops) Tree Crops/Trees (+ medical crops + Cover Crop/Grasses)	Provision of: - Agro-forestry Development ・Tree crop/tree seedling ・Fertilizer/compost ・Labor cost (incentives) - Farming support ・Soil ameliorant ・Farm inputs Extension Services: ・Formation/empowerment of farmer groups ・Training program ・Field programs ・Livestock support program
Housing 2/	> 8%		**H S 2 ~ S 5**	**No physical measures planned**	1. Fringe of Housing Yard 1) Erosion Mitigation in Housing Yard Establishement of hedge rows around housing yard	Shrubs - Serengan jantan *(Flemingia congesta Roxb)*	Provision of: ・Tree seedling ・Labor cost (incentives)

1/: Kinds of tree crops/trees: to be selected by beneficiaries on need basis 2/: Housing yard

Table 9.3.9 Land Management & Agricultural Promotion Measures in Dry Farm Land (1/2)

Subject/Measures	Description/Objectives
1. Land Management for Soil & Water Conservation	
1-1. Farm Land Improvement	
- Dissemination of benefits of soil & water conservation	- Dissemination of benefits of soil & water conservation through mass guidance & other extension activities integrated with implementation of soil & water conservation measures
- Terrace management	- Terrace improvement with adequate vegetative measures; soil & water conservation measures
- Soil management/improvement	- Improvement of soil chemical & physical properties & soil productivity through; • Application of organic fertilizer or matter; dissemination of quality compost making • Introduction of cover/fodder crops in MT II to apply organic matter & provide vegetative cover • Planting of seasonal grasses or legumes for soil improvement & livestock development
- Soil surface cover management/improvement	- Improvement soil surface cover through; • Mulching using crop residues, especially in MT II • Introduction of cover/fodder crops in MT II to provide vegetative cover & apply organic matter • Introduction of riley cropping by multiple cropping of palawija of different growth duration; ex. maize 110 days + soybeans 90 days • Cultivation of leguminous crops of favorable surface cover in the edge of terrace; ex. maize in center of bench with groundnut in the edge
1-2. Land Use Modification/Conversion	- Land use conversion of farm land to orchard/forest in critical lands of slope class **> 40 %;** aiming at land productivity improvement & soil conservation - Establishing soil conservation oriented land use by promoting agro-forestry measures - Promotion of planting perennial crops to reduce labor requirements in farming; next generation appears to have less interested in farming & labor shortage problems slated
2. Agro-forestry Promotion	
2-1. Promotion of Agro-forestry	- Promotion of agro-forestry as a measure for agricultural promotion as well as soil & water conservation based on land suitability, marketability & paying due consideration to annual & long term productivity & economic value; selection of plants should be based on beneficiaries preference - Collaborative & integrated measures of agricultural (estate & fruit crops) & forestry measures in promotion of agro-forestry
3. Improvement of Pekarangan Use	
3-1. Improvement of Vegetative Cover & Productivity	- Establishment of well managed pekarangan with sufficient tree crops & improved land forms - Modification of land use in pekarangan toward soil & water conservation oriented use

Table 9.3.9 Land Management & Agricultural Promotion Measures in Dry Farm Land (2/2)

Subject/Measures	Description/Objectives
4. Crop Sub-sector Measures	
4-1. Improvement of Cropping System	
1) Improvement of Cropping Pattern	Improvement of Cropping Pattern & System
- Single Cropping in MT 1	
• Maize/Cassava - Fallow	- Improvement of productivity & inclusion of beans in MT 1 (ex. rows of beans in the lower edge of terrace bench) - Inclusion of beans/drought tolerant crops in MT II; inclusion of leguminous cover crops in MT II - Preventing cassava planting on terrace lip & riser
• Multiple Crops with Beans/Cassava - Fallow	- Inclusion of beans/drought tolerant crops in MT II; inclusion of leguminous cover crops/sorghum in MT II
• Multiple Crops without Beans/Cassava - Fallow	- Inclusion of beans/drought tolerant crops in MT II; inclusion of leguminous cover crops/sorghum in MT II - Improvement of productivity & inclusion of beans in MT 1 (ex. rows of beans in the lower edge of terrace bench) - Preventing cassava planting on terrace lip & riser
- Double Cropping in MT 1 & MT 2	
• Maize/Cassava - Maize	- Improvement of productivity & inclusion of beans in MT 1 (ex. rows of beans in the lower edge of terrace bench) - Inclusion of beans or leguminous cover crops in MT II - Preventing cassava planting on terrace lip & riser
• Multiple Crops with beans/Cassava - Beans	- Improvement of productivity of beans in MT I - Preventing cassava planting on terrace lip & riser
• Multiple Crops without beans/Cassava - Beans	- Improvement of productivity & inclusion of beans in MT 1 (ex. rows of beans in the lower edge of terrace bench) - Preventing cassava planting on terrace lip & riser
2) Improvement of Farming Practices	- Appropriate fertilization including organic fertilizer; technical training on quality compost preparation - Use of quality seeds, especially in MT I - Introduction of mulching & stable mulch; minimum tillage in MT II
4-2. Technology Development	- Adaptability test of promising bean varieties - Riley cropping to ensure vegetative cover in critical period for erosion from January to March - Adaptability test of shade tolerant crops, drought tolerant crops & other promising crops - Technology development on tree crops production on long term basis
4-3. Palawija Seed Production	- Activation of Seed Farm through renovation & capacity building - Development of soybeans & groundnut seed production technology by the Seed Farm - Formation of palawija seed growers farmer groups & production/supply of seeds in a district
5. Livestock Sub-sector Measures	
5-1. Livestock Promotion	- Implementation of livestock promotion programs (such as introduction of quality breeds & improved of feeding practices and strengthening of veterinary & extension services) integrated with soil conservation vegetative measures

Table 10.6.1 Impact Matrix for Candidate Project Components in the Master Plan

Environmental Elements / Candidate Project Components		Physical Environment								Natural Environment			Socio-economic Environment					
		Topography and Geology	Soil erosion	Waste (Dredged/excavated material)	Groundwater (well water use)	Water quality (Bengawan Solo river)	Water quality (Wonogiri reservoir)	Air quality (emission gas, dust.)	Noise and vibration	Terrestrial flora and fauna	Aquatic flora and fauna	Protected species and areas	Land acquisition and Resettlement	People's unrest and conflict/opposition	Change of income / livelihood	Impacts on agriculture, fishery, forestry	Impacts on downstream area	Traffic and transportation
a. Countermeasures for Sediment Deposits and Garbage at Intake	Modification of the intake					-		-	-		-				+	-		-
	Relocation of the intake	-		-1		-		-1	-2		-			-	+1	-		-1
	Garbage trapping structure at intake			-		-		-	-		-				+	-		-
	Garbage trapping structure at Keduang river			-1			+	-	-		-			-	+	-		-
	Hydro-suction sediment removal system					-1	+	-	-		-1				+			-
	Hydraulic dredging			-1			+						-	-	+			
b. Countermeasures for Sediment Inflow from Keduang river	Keduang river sediment bypass	-1		-2	-2	-2	+1	-1	-2		-2		-1	-2	+2	-1	-	-1
	Sediment slucing by new gates			-2		-2	+1	-1	-1		-2		-1	-	+1	-1	-	-1
	Compartmented reservoir with new flushing gates			-2		-2	+1	-1	-1		-2		-1	-	+1	-1	-	-1
c. Countermeasures for Sediment Inflow from Other Tributaries	Sediment storage dam fro sediment removal			-1			+	-	-		-			-	+	-		-
	Hydraulic dredging in reservoir			-1			+				-		-	-	+	-		
	Dry excavation in reservoir	-1		-2	-		+	-2	-2	-			-1	-1	+2	-1		-1
	Managing of sediments within reservoir by water releasing from the intake						+							-1				
	Re-allocation of reservoir storage capacity				-1			-1	-1				-3	-3	+1	-1		-1
d. Watershed Conservation	Community-based soil conservation		+2		+	+1	+1	-		+1					+1	-		
e. No Action	Do nothing for sedimentation problem		-3	-1	-	-	-2			-	-2			-1	-2	-2	-	

Note) "-": Negligible negative impact, "-1": Minor negative impact, "-2": Medium negative impact, "-3": Significant negative impact.
"+": Negligible positive impact, "+1": Minor positive impact, "+2": Medium positive impact, "+3": Significant positive impact.

Table 10.6.2 Evaluation of Candidate Project Components

(1) Countermeasures for Sediment Deposits and Garbage at Intake

Candidate Project Components	Negative Impact			Positive Impact	Evaluation
	Pre-construction	Construction	Operation	All Stages	
Modification of the intake		-1		+1	○
Relocation of the intake	-	-2		+1	△
Garbage trapping structure at intake		-1	-	+	○
Garbage trapping structure at Keduang river	-	-1	-	+1	○
Hydro-suction sediment removal system		-1	-1	+1	○
Hydraulic dredging	-		-1	+1	○

(2) Countermeasures for Sediment Inflow from Keduang River

Candidate Project Components	Negative Impact			Positive Impact	Evaluation
	Pre-construction	Construction	Operation	All Stages	
Keduang river sediment bypass	-2	-2	-2	+2	×
Sediment sluicing by new gates	-1	-1	-2	+2	△
Compartmented reservoir with new flushing gates	-1	-2	-2	+2	△

(3) Countermeasures for Sediment Inflow from Other Tributaries

Candidate Project Components	Negative Impact			Positive Impact	Evaluation
	Pre-construction	Construction	Operation	All Stages	
Sediment storage dam for sediment removal	-	-1	-1	+	○
Hydraulic dredging in reservoir	-		-2	+	○
Dry excavation in reservoir	-2		-2	+1	△
Managing of sediments within reservoir by water releasing from the intake			-1	+1	○
Re-allocation of reservoir storage capacity	-3	-2	-1	+1	×

(4) Countermeasues for Watershed Conservation

Candidate Project Components	Negative Impact			Positive Impact	Evaluation
	Pre-construction	Construction	Operation	All stages	
Community-based soil conservation	-	-		+2	○

－: Negligible negative impact, －1: Minor negative impact, －2: Medium negative impact, －3: Significant negative impact

+: Negligible positive impact, +1: Minor positive impact, +2: Medium positive impact, +3: Significant positive impact

○: Good, △: Fair, ×: Not Recommended

Table 11.4.3 Project Cost of Sediment Storage Reservoir with New Gates

No.		Description	Unit	Quantity	Unit Cost (US$)	Cost (US$, thousand)
I	**Diect cost**					
	A	Spillway				
		/1 Excavation	m^3	502,580	3	1,510
		/2 Backfill	m^3	46,470	4	190
		/3 Concrete	m^3	35,110	113	3,970
		/4 Reinforcing bar	t	1,756	813	1,430
		/5 Gate, radial	t	170	18,600	3,160
		/6 Excavation, fore bay	m^3	183,000	5	920
		Sub Total A				*11,180*
	B	Closure dike				
		/1 Filling, for dike	m^3	47,320	6	280
		/2 Steel sheet pile	t	4,452	1,200	5,340
		/3 Concrete, capping	m^3	3,300	13	40
		/4 Reinforcing bar	t	165	813	130
		Sub Total B				*5,790*
	C	Overflow dike				
		/1 Excavation	m^3	20,000	3	60
		/2 Concrete	m^3	5,000	113	570
		Sub Total C				*630*
	D	Sub total, A to C				*17,600*
	E	Other works (35% of D)				*6,160*
	F	Sub total, D to E				*23,760*
	G	Temporary works (10% of F)				*2,380*
	H	**Direct construction cost** (Total F and G)				***26,140***
II	**Government administration and Engineering service cost** (15% of H)					***3,920***
III	**Pysical contingency** (20% of I and II)					***6,010***
	Grand Total					**36,070**

Source: JICA Study Team

Table 11.4.4 Procurement Cost of Dredger

No.		Description	Unit	Quantity	Unit Cost (US$)	Cost (US$, thousand)
I	**Diect cost**					
	A	Equipment				
		/1 Cutter-suction dredger, 600PS	nr.	1	2,969,200	2,970
	B	Other equipments (15% of A)				446
	C	**Direct construction cost** (Total A and B)				***3,416***
II	**Pysical contingency** (5% of I)					***170***
	Grand Total					**3,586**

Source: JICA Study Team

Table 11.4.5 Project Cost by Watershed Conservation

Item	Unit	Unit Cost	Entire basin		Kuduang		Tirtomoyo		Temon		Upper Solo		Alang		Ngunggahan		Wuryantoro		Remnant	
			Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
		($)		($, thous.)		($, thous.)		($, thous.)		($, thous.)		($, thous.)		($, thous.)		($, thous.)		($, thous.)		($, thous.)
I. Construction cost																				
1. Land preparation																				
1) Terracing																				
(1) Cutting and filling	m3	0.69	22,224,000	15,335	5,269,000	3,636	4,675,000	3,226	1,073,000	740	5,588,000	3,856	2,521,000	1,739	1,512,000	1,043	936,000	646	650,000	449
2) Waterway and drop																				
(1) Stone material	m3	8.48	164,000	1,391	45,000	382	39,000	331	8,000	68	38,000	322	15,000	127	9,000	76	6,000	51	4,000	34
(2) Excavation	m3	0.58	191,000	111	62,000	36	36,000	21	10,000	6	37,000	21	19,000	11	9,000	5	11,000	6	7,000	4
(3) Masonry work	m3	10.64	149,000	1,585	41,000	436	36,000	383	7,000	74	34,000	362	13,000	138	8,000	85	6,000	64	4,000	43
3) Lip and rizer, planting																				
(1) Seedling, grass, for lip	nr.	0.01	304,731,000	3,047	86,107,000	861	70,106,000	701	15,397,000	154	68,341,000	683	28,070,000	281	16,178,000	162	12,213,000	122	8,319,000	83
(2) Seedling, shrub, for lip	nr.	0.07	18,284,000	1,280	5,166,000	362	4,206,000	294	924,000	65	4,101,000	287	1,684,000	118	971,000	68	733,000	51	499,000	35
(3) Seedling, grass, for riser	nr.	0.0015	432,330,000	648	119,414,000	179	103,112,000	155	21,334,000	32	98,913,000	148	38,625,000	58	22,905,000	34	16,181,000	24	11,846,000	18
(4) Planting work, for lip	m	0.01	91,420,000	914	25,833,000	258	21,032,000	210	4,619,000	46	20,502,000	205	8,421,000	84	4,853,000	49	3,664,000	37	2,496,000	25
(5) Planting work, for riser	m2	0.02	86,466,000	1,729	23,883,000	478	20,622,000	412	4,267,000	85	19,783,000	396	7,725,000	155	4,581,000	92	3,236,000	65	2,369,000	47
2. Side ditches (housing yard)																				
1) Side ditch																				
(1) Stone material	m3	8.48	37,000	314	20,000	170	7,000	59	1,000	8	5,000	42	1,000	8	1,000	8	1,000	8	1,000	8
(2) Excavation	m3	0.58	53,000	31	28,000	16	11,000	6	2,000	1	7,000	4	2,000	1	1,000	1	1,000	1	1,000	1
(3) Masonry work	m3	10.64	33,000	351	18,000	192	7,000	74	1,000	11	4,000	43	1,000	11	1,000	11	1,000	11	-	-
2) Hedge row																				
(1) Shrub, for hedge row	nr.	0.07	8,346,000	584	4,442,000	311	1,690,000	118	282,000	20	1,130,000	79	304,000	21	221,000	15	189,000	13	90,000	6
(2) Planting work, hedge row	m2	0.02	1,043,000	21	555,000	11	211,000	4	35,000	1	141,000	3	38,000	1	28,000	1	24,000	-	11,000	-
3. Agro-forestry and annual crop																				
1) Agro-forestry and annual crop	L.S			10,093		3,125		2,033		538		2,085		992		521		527		272
4. Support program																				
1) Support program	L.S			2,974		981		595		149		595		268		149		149		90
Sub-total for I.				40,408		11,434		8,622		1,998		9,131		4,013		2,320		1,775		1,115
II. Government administration and engineering service cost (10% of I.)		10%		4,041		1,143		862		200		913		401		232		178		112
III. Physical contingency (10% of total of I. and II.)		10%		4,445		1,258		948		220		1,004		441		255		195		123
Project Cost (total of I., II. and III.)				**48,894**		**13,835**		**10,433**		**2,418**		**11,049**		**4,856**		**2,807**		**2,148**		**1,349**

Source: JICA Study Team

Table 11.5.4 PDM of Urgent Countermeasures (1/2)

Project Name: Construction of Sediment Storage Reservoir with New Gates in the Wonogiri Reservo
Target Area: In/around the Wonogiri Reservoir **Project Period: 4 years**

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Long-term ability of the Wonogiri reservoir function will be secured for 100 years.	1)Decreasing ration of the effective storage volume in the reservoir 2) Water supply to the Wonogiri irrigation area	Reservoir sedimentation survey and monitoring of water supply	There will be no drastic change in reservoir management policy of Government of Indonesia
Project Purpose 1) The existing intake structure will be completely reloeved from the sediment and garbage inflow from the Keduang River. 2) Majority of sediment and garbage from the Keduang River will released from the new gates to the vdownstream reach from the dam.	1) Sediment deposition level at the intake (every 2 month) 2) Frequency of interruption of power generation and water supply 3) Volume of released sediment from the new gates	1) Echo sounding survey at the intake 2) Operation record of power generation and water supply	1) PJT I Bengawan Solo will operate the sediment storage reservoir according to the new operation rule. 2) PJT I Bengawan Solo will conduct sedimentation survey at the intake periodically.
Outputs Sediment storage reservoir with new gates will be constructed in the Wonogiri reservoir.	Visible confirmation	Surver record Progress report, completion report and evaluation report of the construction stage	1) The sediment storage reservoir will be operated according to the reservoir operation rule and maintained properly. 2) Maintenance dredging at the intake will be conducted periodically.
Activities Construction of: 1) Sediment stodrage reservoir with new gates in the Wonogiri reservoir, 2) Closure and overflow dikes Socialization of downstream residents (stakeholders) for the construction	***Inputs*** Janapnese side: Funding assistance for construction of the sediment storage reservoir with new gates Indonesian side: Government administration Allocation of proper O&M cost by PJT I Bengawan Solo		Construction cost does not increase drastically. ***Pre-conditions*** 1) The watershed condition does not change drastically from the condition in 2006. 2) The demand of water supply from the reservoir does not change drastically. 3) Water quality of the downstream reach is not drastically deteriorated.

Source: JICA Study Team

Table 11.5.4 PDM of Urgent Countermeasures (2/2)

Project Name: Watershed Conservation in Keduang River Catchment
Target Area: Keduang River Watershed **Project Period: 3 years**

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Long-term ability of the Wonogiri reservoir function will be secured for 100 years.	1)Decreasing ration of the effective storage volume in the reservoir 2) Water supply to the Wonogiri irrigation area	Reservoir sedimentation survey and monitoring of water supply	There will be no drastic change in reservoir management policy of Government of Indonesia
Project Purpose 1) Annual sediment inflow from the Keduang River will be reduced from 1.22 million m3 to 0.80 million m3. 2) Agricultural productivity will be increased with provision of next generation of farmers with resources of another agricultural income.	1) Sediment deposition in the reservoir (every 3 year) 2) Increase of agricultural productivity 3) Balance of cash flow of farmers	1) Echo sounding survey in the reservoir 2) Operation record of power generation and water supply	1) Aspiration of local farmers to particiaprte in the watershed conservation does not change drastically. 2) Cooperation efforts of line agencies concerned does not chgane drastically. 3) Aspiration of local farmers to maintain the rehabilitated terrace does not change drastically.
Outputs In the watershed of Keduang river, 1) K2TAs will be established in the selected area. 2) Farmers understandings on the importance of land and water conservation will be deepened in the selected areas. 3) Demonstration plots will be prepared and managed by the key farmers. 4) 11,260 ha of upland field will be rehabilitated through participation of farmers. 5) Agro-forestry will be developed and applied in the selected area.	1) Estbalishment of committee anf farmer groups 2) Progress of project works and supporting program 3) Record of demonstration plots 4) Number of participants for the works and supporting program 5) Change of land use, cropping pattern, terrace improvement, framing practices, etc. 6) Change of income of village/groups 7) No. of request and discussion with the executing agency 8) Change of the project plan	1) Surver report 2) Record of weekly and monthly meeting (monitoring on members 3) Monitoring surver	1) Aspiration of local farmers to particiaprte in the watershed conservation does not change drastically. 2) Cooperation of line agencies concerned does not chgane drastically.
Activities 1) Formulation of K2TA 2) Farmer training on: -Land & water conservation -Terrace formation, improvement and rehabilitation -Agro-forestry development 3) Making demonstration plot 4) Farm input supply 5) Labor cost subsidy 6) Field staff training on soil & water conservation	***Inputs*** Janapnese side: Funding assistance for implementation of watershed conservation Indonesian side: Government administration Technical and financial support program for land management and agricultural promotion		1) Cost of the farm input and the materials for terrace rehabilitation do not change dramatically. 2) Needs of upland farmer is not changed. ***Pre-conditions*** 1) The watershed condition does not change drastically from the condition in 2006. 2) The demand of water supply from the reservoir does not change drastically.

Source: JICA Study Team

Table 11.5.5 PDM of Mid Term Countermeasures

Project Name: Watershed Conservation in Other River catchments
Target Area: Watershed of Other Rivers **Project Period: 6 years**

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Long-term ability of the Wonogiri reservoir function will be secured for 100 years.	1)Decreasing ration of the effective storage volume in the reservoir 2) Water supply to the Wonogiri irrigation area	Reservoir sedimentation survey and monitoring of water supply	There will be no drastic change in reservoir management policy of Government of Indonesia
Project Purpose 1) Annual sediment inflow from other tributaries will be reduced from 1.96 million m3 to 1.04 million m3. 2) Agricultural productivity will be increased with provision of next generation of farmers with resources of another agricultural income.	1) Sediment deposition in the reservoir (every 3 year) 2) Increase of agricultural productivity 3) Balance of cash flow of farmers	1) Echo sounding survey in the reservoir 2) Operation record of power generation and water supply	1) Aspiration of local farmers to particiaprte in the watershed conservation does not change drastically. 2) Cooperation efforts of line agencies concerned does not chgane drastically. 3) Aspiration of local farmers to maintain the rehabilitated terrace does not change drastically.
Outputs In the watershed of other tributaries, 1) K2TAs will be established in the selected area. 2) Farmers understandings on the importance of land and water conservation will be deepened in the selected areas. 3) Demonstration plots will be prepared and managed by the key farmers. 4) 23,120 ha of upland field will be rehabilitated through participation of farmers. 5) Agro-forestry will be developed and applied in the selected area.	1) Estbalishment of committee anf farmer groups 2) Progress of project works and supporting program 3) Record of demonstration plots 4) Number of participants for the works and supporting program 5) Change of land use, cropping pattern, terrace improvement, framing practices, etc. 6) Change of income of village/groups 7) No. of request and discussion with the executing agency 8) Change of the project plan	1) Surver report 2) Record of weekly and monthly meeting (monitoring on members 3) Monitoring surver	1) Aspiration of local farmers to particiaprte in the watershed conservation does not change drastically. 2) Cooperation of line agencies concerned does not chgane drastically.
Activities 1) Formulation of K2TA 2) Farmer training on: -Land & water conservation -Terrace formation, improvement and rehabilitation -Agro-forestry development 3) Making demonstration plot 4) Farm input supply 5) Labor cost subsidy 6) Field staff training on soil & water conservation	***Inputs*** Janapnese side: Funding assistance for implementation of watershed conservation Indonesian side: Government administration Technical and financial support program for land management and agricultural promotion		1) Cost of the farm input and the materials for terrace rehabilitation do not change dramatically. 2) Needs of upland farmer is not changed. ***Pre-conditions*** 1) The watershed condition does not change drastically from the condition in 2006. 2) The demand of water supply from the reservoir does not change drastically.

Source: JICA Study Team

Table 11.6.2 Economic Cost of Proposed Projects in Master Plan

(Unit:US$ thousand)

Countermeasures	Total Cost / Financial	Total Cost / Economic	Conversion Factor
1. Urgent Countermeasures for Garbage and Sediment Inflow from Keduang River			
a. Sediment Storage Reservoir with New Gates	36,070	25,610	0.71
b. Watershed Conservation in Keduang Catchment	13,835	12,778	(Total works both by government and beneficiary) x CF
c. Procurement of One Dredger	3,586	3,586	1.00
Sub-total	***53,491***	***41,974***	
2.Mid Term Countermeasures for Sediment Inflow from Other Tributaries			
d. Watershed Conservation in Ohter Basins	***35,060***	***36,134***	(Total works both by government and beneficiary) x CF
Grand Total	**88,551**	**78,108**	

(Unit:US$ thousand)

O&M	Total OM Cost/ Financial	Total OM Cost / Economic	Conversion Factor
a. Sediment Storage Reservoir with New Gates	14	11	0.8
b. Watershed Conservation in Keduang Catchment	5	4	0.8
c. Procurement of One Dredger	59	47	0.8
d. Watershed Conservation in Ohter Basins	16	13	0.8
Grand Total	**94**	**75**	

Source: JICA Study Team

Table 11.6.3 Economic Project Cost in the Wonogiri Watershed Conservation Project

Items		Total Project Work	Financial Unit Cost	Econimic Factor*	Economic Unit Cost	Economic Cost
		(1,000)	($)		($)	(1,000$)
(I) Direct Cost						
1. Land preparation						
1) Terracing	unit:					
(1) Cutting and filling	m^3	22,224	0.92	0.75	0.69	15,335
2) Waterway and drop						
(1) stone material	m^3	164	8.48	0.90	7.632	1,252
(2) Excavation work	m^3	191	0.78	0.75	0.585	112
(3) Masonry work	m^3	149	14.23	0.75	10.6725	1,590
3) Lip and rizer, planting						
(1) Seedling, grass for lip	nr.	304,731	0.01	0.90	0.009	2,743
(2) Seedling, shrub for lip	nr.	18,284	0.07	0.90	0.063	1,152
(3) Seedling, grass, for rizer	nr.	432,330	0.0015	0.90	0.00135	584
(4) Planting work, for lip	m	91,420	0.02	0.75	0.012	1,097
(5) Planting work, for rizer	m2	86,466	0.04	0.75	0.03	2,594
2. Side diches (for housing yard)						
1) Side ditch						
(1) Stone material	m^3	37	8.48	0.90	7.632	282
(2) Excavation work	m^3	53	0.78	0.75	0.585	31
(3) Masonry work	m^3	33	14.23	0.75	10.6725	352
2) Headgerow						
(1) Shrub, for hedger row	nr.	8,346	0.07	0.90	0.063	526
(2) planting work, hedge row	m2	1,043	0.04	0.75	0.03	31
3. Agro-forestry and annual crops						
1) Agro-forestry and annual crops	Ls		10,093	0.90		9,084
4. Support program						
1) Support program	Ls		4894	0.90		4,405
Total direct cost						**41,168**
(II) Government Admnistration and Engineering cost						
(10% of total direct cost)				0.90		3,705
(II) Pysical Contingency						
(10% of total cost of I andII)				0.90		4,039
Total economic cost						**48,912**

*: Conversion factor of unskilled labor: 0.75, Standard conversion factor for materials:0.9
Source: JICA study team

Table 11.6.8 Summary of Crop Input and Output Prices (2005 Rp. Prices)

Item	Unit	Financial Price 2005	CF	Economic Price
1. Outputs				
Rice (Mentik)	Rp./kg	3,100		2,780
Green bean	Rp./kg	4,500		
Soybean	Rp./kg	2,250		2,740
Ground bean	Rp./kg	7,000		
Cassava	Rp./kg	500		
(Tolo)	Rp./kg	2,500		
Kacang panjang		2,000		
2. Inputs				
Fertilizer				
Urea	Rp./kg	1,500		2,698
Triple Superphosphate (TSP)	Rp./kg	1,800		1,798
Potassium Chloride (KCL)	Rp./kg	3,000		1,465
Other Inputs				
Wet grain of rice	Rp./kg	1,400	0.9	1,260
Contract Mechanical Operations				
Land Preparation	Rp./ha	300,000	0.75	225,000
Agricultural Labor				
Person	md	25,000	0.75	18,750

BPS Kabupaten Sukoharjo; village administration (desa Pringanom/ kecamatan Masaran/ kabupaten Sragen); February 2006
World Bank Commodity Price Projections, May 2000

Table 11.6.9 Border Parity Prices of Crops; Constant 2005 Economic Prices, USD per ton, Rp. per kg

Commodity		**Rice**	**Soybean**
Export/ Import Substitute		Imported	Imported
Market Product Location		Thailand	FOB US Gulf Port, Rotterdam
Quality of Marker Product		5% broken	
		2005	2005
USD/ton			
Indicator Price	=	308.2	227.6
Quality Differential	x	0.90	1.00
Equivalent Value of Indoneisan Product	=	277.4	227.6
Freight and Insurance Cost to Semarang	+	25.0	40.0
Value at Indonesian Port	=	302.4	267.6
Rp./kg			
(exchange rate)		10,035	10,035
Value at Indonesian Port	=	3,034	2,685
Port Handling Charges, Storage and Loss	+	118	104
Internal Handlihg/ Transport Cost - Near Port	+	15	15
Value at Wholesale Market	=	3,167	2,804
Transport Costs, Local to Wholesale Market	-	36	38
Dealer Handling and Processing Costs	-	28	13
Value at Local Market/ Processor/ Mill	=	3,103	2,753
Milling Cost	-	310	
Transport Cost-Fargate to Local Market/ Mill	-	13	13
Value at Farmgate	=	2,780	2,740

Commodity		**Urea**
Export/ Import Substitute		Exported
Market Product Location		Northern Europe
Quality of Marker Product		
		2005
USD/ton		
Indicator Price	=	109.2
Quality Differential	x	1.10
Equivalent Value of Indoneisan Product	=	120.1
Freight and Insurance Cost	+	30.0
Value at Indonesian Port	=	150.1
Rp./kg		
(exchange rate)		10,035
Value at Indonesian Port of Exit Palembang	=	1,506
Internal Handling Charges/ Transport to Central Java	+	30
Value at Wholesale Market	=	1,536
Transport Costs, Wholesale to Farmgate	+	40
Value at Farmgate (fertilizer)	=	1,576
Value at Farmgate (nutrient)	=	2,698

Commodity		**TSP**	**KCL**
		Triple Superphosphate	Potassium Chloride
Export/ Import Substitute		Imported	Imported
Market Product Location		Northern Europe/ Florida	Northern Europe, Canada
Quality of Marker Product			
		2005	2005
USD/ton			
Indicator Price	=	145.7	113.8
Quality Differential	x	1.00	1.00
Equivalent Value of Indoneisan Product	=	145.7	113.8
Freight and Insurance Cost	+	20.0	20.0
Value at Indonesian Port	=	165.7	133.8
Rp./kg			
(exchange rate)		10,035	10,035
Value at Indonesian Port of Entry	=	1,663	1,343
Port Charges	+	65	52
Internal Handling/ Transport Costs - Near Port	+	30	30
Value at Wholesale Market	=	1,758	1,425
Transport Costs, Wholesale to Farmgate	+	40	40
Value at Farmgate (fertilizer)	=	1,798	1,465

Source: World Bank Commodity Price Projections, May 2000

Table 11.6.10 Crop Budget per ha

Crop Budget per Ha, Present Condition/ Financial Price

	Unit	Paddy (Dry Season I & II)				Soybeans			
		Quantity	Unit rate [Rp.]	['000Rp.]	[USD]	Quantity	Unit rate [Rp.]	['000Rp.]	[USD]
1. Crop Yield	t/ha	5.5				1.5			
2. Unit Price	Rp./kg		3,100				2,250		
3. Gross Return	000Rp.			17,050	1,699			3,375	336
4. Production Cost	000Rp.			3,679	367			2,317	231
Farm Inputs									
Seed	kg/ha	30	1,400	42		60	3,200	192	
Fertilizer/ Agro-chemical									
Urea	kg/ha	225	1,500	338		100	1,500	150	
TSP	kg/ha	150	1,800	270		50	1,798	90	
KCL	kg/ha	100	3,000	300					
ZA	kg/ha	100	1,500	150					
Insecticide	kg	2.9	100,000	290		3.5	100,000	350	
Hired Labor	md	72	25,000	1,800		45	25,000	1,125	
Family Labor	md	73				45			
Land Preparation cost	Rp./ha	1	300,000	300		1	300,000	300	
Miscellaneous		5%		189		5%		110	
5. Net Return	**000Rp.**			**13,371**	**1,332**			**1,058**	**105**

Source: Technical Report for Wonogiri Irrigation Project, 2000 updated with 2005 commodity prices (originally based on F/S 1976)
Exchange rate (Dec.2005): 1 USD = 10,035 Rp.

Crop Budget per Ha, Present Condition/ Economic Price

	Unit	Paddy (Dry Season I & II)				Soybeans			
		Quantity	Unit rate [Rp.]	['000Rp.]	[USD]	Quantity	Unit rate [Rp.]	['000Rp.]	[USD]
1. Crop Yield	t/ha	5.5				1.5			
2. Unit Price	Rp./kg		2,780				2,740		
3. Gross Return	000Rp.			15,290	1,524			4,111	410
4. Production Cost	000Rp.			3,211	320			2,012	201
Farm Inputs									
Seed	kg/ha	30	1,260	38		60	2,880	173	
Fertilizer/ Agro-chemical									
Urea	kg/ha	225	2,698	607		100	2,698	270	
TSP	kg/ha	150	1,798	270		50	1,798	90	
KCL	kg/ha	100	1,465	146					
ZA	kg/ha	100	1,500	150					
Insecticide	kg	2.9	90,000	261		3.5	90,000	315	
Hired Labor	md	72	18,750	1,350		45	18,750	844	
Family Labor	md	73				45			
Land Preparation cost	Rp./ha	1	225,000	225		1	225,000	225	
Miscellaneous		5%		164		5%		96	
5. Net Return	**000Rp.**			**12,080**	**1,204**			**2,098**	**209**

Source: Technical Report for Wonogiri Irrigation Project, 2000 updated with 2005 commodity prices (originally based on F/S 1976)
Exchange rate (Dec.2005): 1 USD = 10,035 Rp.

Table 11.6.13 Assumptions Applied for Cropping Pattens

Item	Assumptions Applied for Analysis
1. Target agricultural activities	Crop sub-sector in upland field
2. Farm size of typical farm	Upland field: net cultivable area 0.5 ha/farm
3. Duration of analysis	15 years
4. Current cropping pattern	Pattern for uplands with slope classes of 0 ~ 25% MT I: maize (hybrid; intensity 100%) + cassava (intensity 20%) MT II: groundnut (intensity 40%) + cassava (intensity 20%) MT III: cassava (intensity 20%)
	Pattern for uplands with slope classes of above 25% MT I: maize (composite; intensity 100%) + cassava (intensity 20%) MT II: groundnut (intensity 40%) + cassava (intensity 20%) MT III: cassava (intensity 20%)
5. With-project cropping pattern (1) Slope Class: 0 - 8% Typical Farm A-1	1st to 4th year MT I: maize (hybrid; 100%) + cassava (20%) + tree crops (5%) MT II: groundnut (intensity 40%) + cassava (20%) + tree crops (5%) MT III: cassava (20%) + tree crops (5%)
	5th year & after MT I: maize (hybrid; 95%) + cassava (20%) + tree crops (5%) MT II: groundnut (40%) + cassava (20%) + tree crops (5%) MT III: cassava (20%) + tree crops (5%)
(2) Slope Class: > 8 - 15% Typical Farm A-2	1st to 4th year MT I: maize (hybrid; 100%) + cassava (15%) + tree crops (13%) MT II: groundnut (40%) + cassava (15%) + tree crops (13%) MT III: cassava (15%) + tree crops (13%)
	5th year & after MT I: maize (hybrid; 87%) + cassava (10%) + tree crops (13%) MT II: groundnut (40%) + cassava (10%) + tree crops (13%) MT III: cassava (10%) + tree crops (13%)
(3) Slope Class: > 15 - 25% Typical Farm A-3	1st to 4th year MT I: maize (hybrid; 90%) + cassava (10%) + tree crops (25%) MT II: groundnut (40%) + cassava (10%) + tree crops (25%) MT III: cassava (10%) + tree crops (25%)
	5th year & after MT I: maize (hybrid; 75%) + medical crop (10%) + tree crops (25%) MT II: groundnut (30%) + medical crop (10%) + tree crops (25%) MT III: tree crops (25%)
(4) Slope Class: > 25 - 40% Typical Farm B-1	1st to 4th year MT I: maize (hybrid; 75%) + cassava (5%) + tree crops (38%) MT II: groundnut (30%) + cassava (5%) + tree crops (38%) MT III: cassava (5%) + tree crops (38%)
	5th year & after MT I: maize (hybrid; 62%) + medical crop (10%) + tree crops (38%) MT II: groundnut (30%) + medical crop (10%) + tree crops (38%) MT III: tree crops (38%)
(5) Slope Class: > 40% Typical Farm B-2	1st to 4th year MT I: maize (hybrid; 60%) + tree crops (50%) MT II: groundnut (30%) + tree crops (50%) MT III: tree crops (50%)
	5th year & after MT I: Maize (hybrid;50%), tree crops (50%) + medicinal crop (20%) MT II: Groundnut (30%), tree crops (50%) + medicinal crop (20%) MT III: tree crops (50%)

Source: JICA Study Team

Table 11.6.14 Total Economic Benefit from Wonogiri Watershed (1/3)

development year					Slope Class					
					0-8 %	8-15 %	15-25 %	25-40 %	ove 40	Total
			Gross area	**(ha)**	**3,017**	**7,532**	**7,564**	**6,301**	**7,359**	**31,773**
1st year	with project condition	Terrace	Gross area	(ha)	3,017	7,532	7,564	6,301	7,359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.01	2.70	2.01	1.05	0.20	
			Net retun	(Rpmillion)	8,900	18,913	13,531	5,491	1,104	47,939
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,275	486	(4,590)	(5,365)	(10,927)	**(19,120)**
2nd year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	4,184	4,415	31,138
			Net return/ha	(Rp million)	3.06	2.84	2.27	1.42	0.73	
			Net retun	(Rpmillion)	9,047	19,894	15,282	5,941	3,223	53,387
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	68,023
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,423	1,467	(2,840)	(4,915)	(8,808)	**(13,672)**
3rd yea	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.05	2.81	2.22	1.34	0.62	
			Net retun	(Rpmillion)	9,018	19,683	14,945	7,008	3,422	54,076
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	68,712
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,394	1,257	(3,176)	(3,848)	(8,609)	**(12,983)**
4th yeara	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.15	3.08	2.73	2.12	1.65	
			Net retun	(Rpmillion)	9,313	21,575	18,378	11,087	9,107	69,460
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	84,097
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,689	3,148	257	231	(2,924)	**2,401**
5th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.09	2.88	2.75	2.52	2.60	
			Net retun	(Rpmillion)	9,136	20,174	18,513	13,179	14,350	75,352
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	89,988
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,512	1,747	392	2,323	2,319	**8,293**

Table 11.6.14 Total Economic Benefit from Wonogiri Watershed (2/3)

development year					Slope Class					
					0-8 %	8-15 %	15-25 %	25-40 %	ove 40	Total
			Gross area	**(ha)**	**3,017**	**7,532**	**7,564**	**6,301**	**7,359**	**31,773**
6th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.18	3.10	3.18	3.17	3.46	
			Net retun	(Rpmillion)	9,402	21,715	21,408	16,579	19,097	88,200
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	102,836
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,778	3,288	3,286	5,722	7,066	**21,141**
7th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.24	3.27	3.51	3.67	4.11	
			Net retun	(Rpmillion)	9,580	22,906	23,629	19,193	22,684	97,992
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	112,628
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	1,955	4,479	5,508	8,337	10,653	**30,933**
8th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.30	3.42	3.50	3.81	4.09	
			Net retun	(Rpmillion)	9,757	23,956	23,562	19,926	22,574	99,775
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	114,411
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,133	5,529	5,441	9,070	10,543	**32,715**
9th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.36	3.58	4.10	4.57	5.30	
			Net retun	(Rpmillion)	9,934	25,077	27,601	23,900	29,252	115,765
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	130,401
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,310	6,650	9,480	13,044	17,221	**48,706**
10th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.42	3.72	4.37	4.98	5.84	
			Net retun	(Rpmillion)	10,112	26,058	29,419	26,045	32,232	123,865
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	138,501
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,488	7,631	11,297	15,188	20,202	**56,806**

Table 11.6.14 Total Economic Benefit from Wonogiri Watershed (3/3)

development year					Slope Class					
					0-8 %	8-15 %	15-25 %	25-40 %	ove 40	Total
			Gross area	**(ha)**	**3,017**	**7,532**	**7,564**	**6,301**	**7,359**	**31,773**
11th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.47	3.87	4.36	5.11	5.81	
			Net retun	(Rpmillion)	10,260	27,108	29,351	26,724	32,067	125,511
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	140,147
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,636	8,682	11,230	15,868	20,036	**58,451**
12th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.48	3.89	4.69	5.47	6.48	
			Net retun	(Rpmillion)	10,289	27,249	31,573	28,607	35,765	133,482
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	148,119
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,665	8,822	13,452	17,751	23,734	**66,423**
13th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.50	3.93	4.78	5.60	6.65	
			Net retun	(Rpmillion)	10,348	27,529	32,179	29,287	36,703	136,046
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	150,682
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,724	9,102	14,058	18,431	24,672	**68,987**
14th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.51	3.97	4.85	5.71	6.80	
			Net retun	(Rpmillion)	10,378	27,809	32,650	29,862	37,531	138,230
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	152,866
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,754	9,382	14,529	19,006	25,500	**71,171**
15th year	with project condition	Terrace	Gross area	(ha)	3,017	7532	7564	6301	7359	31,773
			Net area	(ha)	2,957	7,005	6,732	5,230	5,519	31,138
			Net return/ha	(Rp million)	3.51	3.97	4.85	5.71	6.80	
			Net retun	(Rpmillion)	10,378	27,809	32,650	29,862	37,531	138,230
	Without project condition	Composite	Gross area	(ha)	1,659	3,163	3,404	3,024	3,385	14,636
			Net area	(ha)	1,659	3,163	3,404	3,024	3,385	152,866
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	4,231	8,067	8,680	5,716	6,398	33,092
		Terrace	Gross area	(ha)	1,358	4,369	4,160	3,277	3,974	17,137
			Net area	(ha)	1,330	4,063	3,703	2,720	2,980	50,229
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rpmillion)	3,393	10,360	9,442	5,140	5,633	33,967
			Benefit	(Rp million)	2,754	9,382	14,529	19,006	25,500	**71,171**

Source: JICA Study Team

Table 11.6.16 Net Present Value and Economic Internal Rate of Return

NPV	50.0 USD Million (12%)
EIRR	16.4%

Unit:USD million

No	Year	B-C	Benefit				Cost								
							Construction				O/M				
			Hydropower Supply	Irrigation Water Supply	Watershed Conservation	Total	Sediment Storage Reservoir	W/C in Keduang	Dredger	W/C in Others	Sediment Storage Reservoir	W/C in Keduang	Dredger	W/C in Others	Total
1	2010	-18.897	0.000	0.000	-0.385	**-0.385**	8.537	6.389	3.586	0.000	0.000	0.000	0.000	0.000	**18.512**
2	2011	-15.128	0.002	0.017	-0.175	**-0.156**	8.537	6.389	0.000	0.000	0.000	0.000	0.047	0.000	**14.973**
3	2012	-8.767	0.005	0.035	-0.219	**-0.179**	8.537	0.000	0.000	0.000	0.000	0.004	0.047	0.000	**8.588**
4	2013	-8.527	0.010	0.076	-1.323	**-1.237**	0.000	0.000	0.000	7.227	0.011	0.004	0.047	0.000	**7.289**
5	2014	-8.023	0.018	0.129	-0.867	**-0.721**	0.000	0.000	0.000	7.227	0.011	0.004	0.047	0.013	**7.302**
6	2015	-7.489	0.026	0.195	-0.408	**-0.187**	0.000	0.000	0.000	7.227	0.011	0.004	0.047	0.013	**7.302**
7	2016	-6.018	0.037	0.273	0.974	**1.284**	0.000	0.000	0.000	7.227	0.011	0.004	0.047	0.013	**7.302**
8	2017	-5.393	0.050	0.363	1.496	**1.909**	0.000	0.000	0.000	7.227	0.011	0.004	0.047	0.013	**7.302**
9	2018	3.292	0.062	0.454	2.851	**3.367**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
10	2019	4.326	0.074	0.545	3.782	**4.401**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
11	2020	4.603	0.087	0.636	3.955	**4.678**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
12	2021	6.083	0.099	0.726	5.332	**6.158**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
13	2022	6.843	0.111	0.817	5.990	**6.918**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
14	2023	51.202	5.409	39.710	6.158	**51.277**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
15	2024	51.723	5.401	39.650	6.747	**51.798**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
16	2025	51.842	5.393	39.590	6.934	**51.917**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
17	2026	51.932	5.385	39.531	7.092	**52.008**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
18	2027	51.865	5.377	39.471	7.092	**51.940**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
19	2028	51.797	5.369	39.411	7.092	**51.872**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
20	2029	51.729	5.360	39.351	7.092	**51.804**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
21	2030	51.661	5.352	39.292	7.092	**51.736**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
22	2031	51.593	5.344	39.232	7.092	**51.668**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
23	2032	51.525	5.336	39.172	7.092	**51.600**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
24	2033	51.457	5.328	39.112	7.092	**51.532**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
25	2034	51.389	5.320	39.052	7.092	**51.464**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
26	2035	51.321	5.312	38.993	7.092	**51.397**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
27	2036	51.253	5.303	38.933	7.092	**51.329**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
28	2037	51.186	5.295	38.873	7.092	**51.261**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
29	2038	51.118	5.287	38.813	7.092	**51.193**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
30	2039	51.050	5.279	38.754	7.092	**51.125**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
31	2040	50.982	5.271	38.694	7.092	**51.057**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
32	2041	50.914	5.263	38.634	7.092	**50.989**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
33	2042	50.846	5.255	38.574	7.092	**50.921**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
34	2043	50.778	5.246	38.515	7.092	**50.853**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
35	2044	50.710	5.238	38.455	7.092	**50.785**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
36	2045	50.642	5.230	38.395	7.092	**50.717**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
37	2046	50.574	5.222	38.335	7.092	**50.650**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
38	2047	50.506	5.214	38.275	7.092	**50.582**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
39	2048	50.439	5.206	38.216	7.092	**50.514**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
40	2049	50.371	5.198	38.156	7.092	**50.446**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
41	2050	50.303	5.189	38.096	7.092	**50.378**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
42	2051	50.235	5.181	38.036	7.092	**50.310**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
43	2052	50.167	5.173	37.977	7.092	**50.242**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
44	2053	50.099	5.165	37.917	7.092	**50.174**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
45	2054	50.031	5.157	37.857	7.092	**50.106**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
46	2055	49.963	5.149	37.797	7.092	**50.038**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
47	2056	49.895	5.141	37.738	7.092	**49.970**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
48	2057	49.827	5.132	37.678	7.092	**49.903**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
49	2058	49.759	5.124	37.618	7.092	**49.835**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**
50	2059	49.692	5.116	37.558	7.092	**49.767**	0.000	0.000	0.000	0.000	0.011	0.004	0.047	0.013	**0.075**

Source: JICA Study Team

Table 11.8.2 Income and Loss Statement, PJT I Bengawan Solo

Rp. million

No	Income/ Loss	Realization			Plan
		2003	2004	2005	2006
I.	**REVENUES**	**3,282**	**5,397**	**6,101**	**6,250**
A.	Water Service	2,844	3,084	4,215	5,225
a.	Hydropower generation (PLN)	1,361	1,062	1,507	1,968
b.	Drinking water (PDAM)	43	151	162	239
c.	Industries	1,440	1,871	2,546	3,018
B.	Non-water Service	438	2,313	1,886	1,025
1	Tourism				
2	Equipment	409	2,278	1,787	950
3	Construction				
4	Consultation				
5	Others	29	35	99	75
II.	**COSTS**	**2,985**	**4,755**	**4,995**	**5,545**
a.	O&M	882	1,314	1,490	1,525
b.	Employment (officials)	1,230	1,513	2,036	2,250
c.	Production services (bonus for employees)		99	149	170
d.	General affairs	212	247	275	345
e.	Transportation (field trips)	226	242	326	410
f.	Services	87	924		
g.	Marketing	82	85	128	140
h.	Depreciation	85	95	152	180
i.	Supervisor board	124	82		
j.	Extension (dissemination of info)	26	24		
k.	Management		25		
l.	HR development	21	40		
m.	R&D		50	50	60
n.	Watershed protection	10	15	65	150
o	Non-water services			324	315
	% O&M in total costs				
III.	**PROFIT/ LOSS**	**297**	**642**	**1,106**	**705**
IV.	**INCOME (NON-OPERATIONAL)**	**347**	**379**		
1	Bank services	5	6		
2	PGPS	342	373		
3	Others				
V.	**COSTS (NON-OPERATIONAL)**		**125**		
VI.	**PROFIT/ LOSS (NON-OPERATIONAL)**	**347**	**254**		
VII.	**PROFIT/ LOSS BEFORE TAX**	**644**	**896**	**1,106**	**705**
1					
2					
VIII.	**INCOME TAX**	**189**	**267**		
1	Current tax	192	273		
2	Outstanding tax	-3	-6		
IX.					
X.					
XI.	**TAX**				
XII.	**PROFIT/ LOSS AFTER TAX**	**455**	**629**	**1,106**	**705**

Source: JICA Study Team