CHAPTER 7 CONSTRUCTION SCHEDULE AND COST ESTIMATE

7.1 Scope of Works for Construction Planning

The following is the scope of works for construction planning of the project:

Table 7.1.1 Scope of Works for Construction Planning

Item	Works
1) Sediment storage reservoir with new gates	
(1) Spillway with gates	<Chute, concrete> - B= 15 m - L= 715 m <Gate, steel> - Radial gate - Two (2) leaves - B= 7.5 m/unit - H= 12.6 m/unit - sill EL.= 127.0 m
(2) Closure dike	<Earthfill> - B= 10 m (crown) - m= 1:3.0 - L= 650 m - H= 8.3 m (max) - crest EL.= 138.3 m
(3) Overflow dike	<Weir, concrete> - B= 10 m (crown) - L= 250 m - crest EL.= 136 m <Reservoir road> - B= 10 m - crest EL.= 138.3 m
2) Procurement of dredger	
(1) Procurement of dredger	<Procurement of equipment> - Cutter-suction dredger, 600PS - Quantity= one (1) unit - Other ancillary equipment
3) Watershed conservation in Keduang River basin	
(1) Land preparation	<Terracing> <Water way and masonry> <Stabilization of lip and riser> - 9,872 ha in gross
(2) Side ditches	<Side ditch, masonry> - At housing yard of 1,388 ha (82 villages)
(3) Agro-forest and annual crop	<Material supply for perennial tree> - Seedling, compost and fertilizer <Material supply for annual crop> - Seed, compost and fertilizer <Planting> - For the area of Item (1) above
(4) Support program	<Material supply for annual crop> - Seed, compost and fertilize <Supporter dispatching> - 82 villages - For soil and water conservation measures - For agricultural promotion - For community development

Source: JICA Study Team

7.2 Conditions and Assumptions for Construction Planning

7.2.1 Natural and Social Conditions

(1) Location, climate, and topography

1) Location

The construction works would be performed in the Wonogiri reservoir and in its upstream basin. The reservoir is located about 110 km southeast of Semarang, the provincial capital of the Central Java.

2) Climate

The climate of Indonesia is tropical; hot, humid; more moderate in highlands. They say that the wet season is the period from November to May in and around the project area. The proposed development area has rainfall of about 2,000 mm a year. The following is the averaged precipitation acquired at an observatory near the Wonogiri dam.

Table 7.2.1 Averaged Rainfall near Project Area

(Unit: mm)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Aver.
332	343	281	187	92	57	36	19	27	76	202	246	1,897

Source: Waduk Krisak peng Skat 34 observatory, Wonogiri, Indonesia; based on daily precipitation data of 1980~2003, except 1985, 1990, 1991, 2001 and 2002 (19 years); sorted by JICA Study Team
The hatched months are the wet season.

3) Topography

The reservoir stores water throughout the year. The water level is controlled between 127 m (LWL, December) and 136 m (HWL, end April/ beginning May). A hard rock zone lies on the left bank of the dam body. The right bank of the dam body has a flat to very gentle gradient. Much of the land to be improved in upstream basin has rather steep gradient, such over 25 %, and most of the steep land has a gradient over 40 %.

(2) Seaport and access

When construction materials and equipment are imported, they will be loaded at the Semarang international seaport. The imported materials and equipment will be transported from Semarang to the site through Surakarta (about 155km).

An asphalt-paved road connects from Semarang to Surakarta (about 125km) and Surakarta to the Wonogiri dam site (about 30km).

(3) Workable days

Construction works would be performed from Monday to Saturday except National holidays. From the possible working days, work suspension days due to rainfall need to be deducted.

The work suspension days are estimated based on the daily precipitation (19 years, 1980-2003, except '85, '90, '91, '01 and '02) of the Waduk Krisak peng Skat 34 observatory that is located near the Wonogiri dam.

The following are the conditions to estimate the work suspension days:

Table 7.2.2 Conditions for Work Suspension Days

Conditions item	Earthworks	Concrete/ rip-rap/ masonry	Dredging/ tunnel works
1. Sundays and national holidays:	1.0	1.0	1.0
2. Rainfall (p)			
0mm < p < 5mm:	0	0	0
5mm < p < 10mm:	0.5	0	0
10mm < p < 20mm:	1.0	0	0
20mm < p < 30mm:	1.0	1.0	0
30mm < p < 50mm:	2.0	1.0	1.0
50mm < p:	3.0	1.0	1.0

Source: JICA Study Team
Note: - Overlapping days of Sunday/holiday with rainy day shall be deducted in counting work suspension days.
- Work suspension days of 1.5, 2.0 and 3.0 mean that the works will be suspended on successive days.

The following are the estimated workable days by type of works:

Table 7.2.3 Estimated Workable Days

Works	J	F	M	A	M	J	J	A	S	O	N	D	Total
1. Earthworks	10	8	13	17	20	23	24	25	24	23	16	16	219
2. Concrete/ riprap/ masonry works	19	16	20	22	23	25	25	26	25	25	21	23	270
3. Dredging/ tunnel works	21	19	22	23	23	25	26	26	25	25	22	24	281

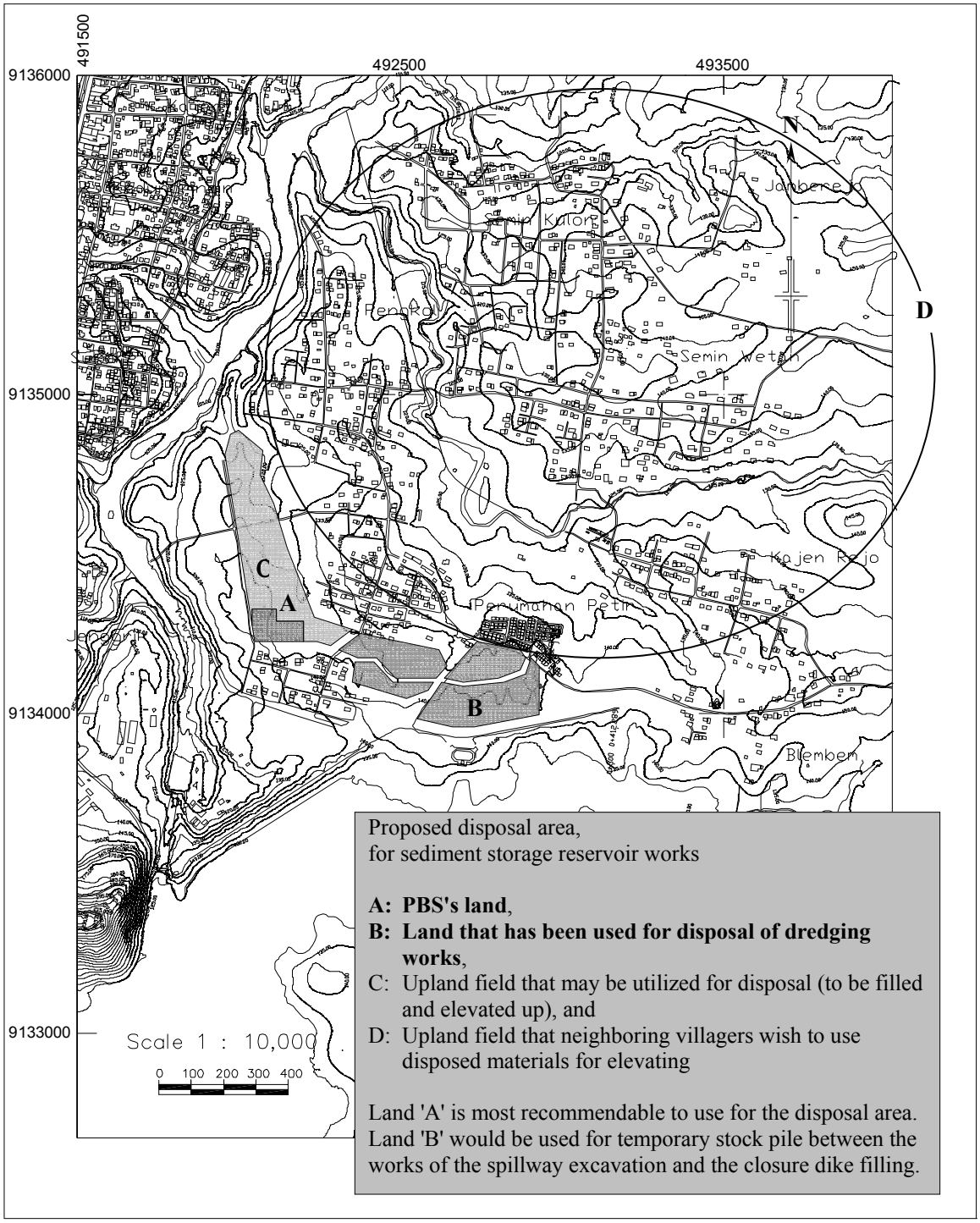
Source: JICA Study Team
Note: - The hatched months are the wet season.

(4) Disposal area

The excavation volume is more than the total fill volume required in the construction works of the sediment storage reservoir. The excavated materials would be diverted for the filling works as much as possible. The following is the earthmoving plan:

- Excavated material would be stocked on the land, located on the right bank of the dam body, which is currently used as the dredging disposal area. Most of the excavated material at the proposed spillway would be stocked in this area and it would be diverted as fill for the closure dike and the reservoir road.
- Finally surplus earth materials would be disposed in the PBS's land located downstream of the dam body.

Locations of these proposed stock/disposal areas are as shown in Figure 7.2.1 below. The hauling distance would be about 1 km for stock/disposal and for the successive filling.



Source: JICA Study Team

Figure 7.2.1 Location of Proposed Disposal Area

7.2.2 Availability of Construction Resources

(1) Labor

Indonesian labor would be employed for all the works.

(2) Construction materials

Metal gates, stop logs and screens (roller/fixed wheel gates and radial/Tainter gates) would be designed in foreign countries and imported for the works. All other construction

materials would be procured from the domestic market of Indonesia.

Ready-mixed concrete is available at the concrete plant factory that is located between Surakarta and Wonogiri.

(3) Construction equipment

Tunnel boring machines (if necessary) and work vessels would be temporary imported for the works. All other construction equipment would be procured from the domestic market of Indonesia.

7.3 Construction Schedule

7.3.1 Sediment Storage Reservoir Works

(1) Spillway

A spillway structure would be constructed at the right bank of the reservoir beside the dam body. A set of two radial gates would be installed at the spillway. Considerable excavation would be required. The excavated materials would be diverted to the proposed closure dike works.

Bulldozers and backhoes (hydraulic excavator) would be used for the excavation. Loaders and dump trucks would be used for hauling the excavated materials. Ready-mixed concrete would be purchased and be placed with a concrete pump truck. A truck crane would be used for installing spillway gates.

The spillway works would be in the following sequence:

i) Excavation for spillway (water way);
ii) Concrete placing for spillway (water way);
iii) Coffering for gate structure;
iv) Excavation for gate structure;
v) Concrete placing for gate structure;
vi) Installation of gates;
vii) Removal of coffer; and
viii) Excavation for fore-bay.

(2) Closure dike

A closure dike would be constructed between the dam site and the peninsula in the reservoir. The dike would be filled with the excavated materials from the proposed spillway site.

Dump trucks would transport the filling materials and a bulldozer and vibratory compactor would spread and compact the dike.

The closure dike works would be in the following sequence:

i) Hauling earth materials for filling; and
ii) Filling for closure dike.

(3) Overflow dike

A reservoir road would be constructed for access to the peninsula. The overflow dike would be constructed in concrete. The weir would have a lock with two gates at both sides of inner and outer reservoir.

Dump trucks would transport the filling materials and a bulldozer and vibratory compactor would spread and compact the reservoir road. Ready-mixed concrete would be purchased for the overflow dike and placed with a concrete pump truck. A truck crane would be used for installing the lock gates.

The overflow dike works would be in the following sequence:

i) Filling for the reservoir road;
ii) Concrete placing for overflow dike; and
iii) Installation of gates for the lock.

The overall work schedule for the sediment storage reservoir is shown in Figure 7.3.1.

7.3.2 Watershed Conservation in the Keduang River Basin

(1) Terracing

New construction or improvement of bench terraces would be performed in the proposed areas of the Keduang River basin, and planting carried out on the lips and risers of the terraced fields (land preparation). After the land preparation, tree crops and annual crops would be planted (crop planting). All these works would be performed by manpower.

The land preparation works would be a sequence of:

i) Top soil treatment (stripping);
ii) Cutting and filling for terracing;
iii) Bench surface improvement to form backward slope;
iv) Excavation for trench (drainage ditch) at riser bottom;
v) Filling for lip at riser top;
vi) Improvement of drainage stream;
vii) Masonry for drop structures;
viii) Purchasing of seedlings;
ix) Planting at risers (BB or lamtoro gung);
x) Planting at lips (elephant grass); and
xi) Initial watering for the plants.

The terracing, other earth and masonry works would be performed in the dry season. The planting works for the riser and lips would be performed at the beginning of the succeeding wet season. The terracing and planting would be performed area by area every year.

(2) Side ditches

Side ditches would be constructed in the proposed housing yard area. The side ditches would be constructed with masonry. All these works would be performed by manpower.

(3) Agro-forestry and annual crops

The crop planting would be also commenced in the successive wet season after land preparation (terracing) in the dry season.

The tree crops would be fertilized for the first three years of the planting. The annual crops would be fertilized for the first year of the planting. The fertilizing works for both tree and annual crops would be part of the initial investment of the project.

(4) Support program

A number of guidance experts would be dispatched to villages in the proposed area for group guidance, agricultural promotion, community development, monitoring and evaluation on the watershed conservation works to support villagers.

(5) Annual work schedule

A sequence of terracing, planting risers and lips, and planting crops would be performed area by area. The sequence of works would be repeated the following year depending on the tributary area for development. The following is the construction schedule for the watershed conservation works:

Table 7.3.1 Schedule for Watershed Conservation Works

Works	J	F	M	A	M	J	J	A	S	O	N	D
Terracing						*	*	*	*	*		
Planting, riser & lip											*	*
Planting, crops										*	*	*
- do - (2nd year)	*	*										

Source: JICA Study Team

Note: *: Active work months
- The hatched months are the wet season.

7.3.3 Procurement of Dredger

(1) Procurement of equipment

A cutter-suction dredger would be procured. The procurement would take 14 months for the ordering, design, manufacturing, transportation, and installation.

(2) Periodic dredging

Dredging would be performed in front of the intake of the reservoir. The length of the discharge pipeline would be about one kilometer from around the intake to the new spillway forebay.

The following are estimation and proposed quantity for the annual dredging:

i) Working period : 6 months/year; wet season (discharging period, December to May, 22 days/month), 132 days/year

ii) Operation hour : 13 hours per day (2-shift)

iii) Dredging depth : 10 m (WL= 136m and sediment level= 127m, April~May)

iv) Type and class of dredger : Cutter-suction dredger, 600 PS (109 m^3/hr/unit x 13 hours/day= 1,417 m^3/day/unit);

v) Estimated work quantity : 132 days/year x 1,417 m^3/day= 187,044 m^3/year

7.3.4 Project Implementation Schedule

The proposed project implementation schedule is as shown in Figure 7.3.2.

7.4 Conditions and Assumptions for Cost Estimate

The basic conditions and assumptions for the cost estimation for the urgent countermeasures in the Master Plan are as set up below:

7.4.1 Price Level

(1) Price level

Price level is set at December 2006.

(2) Exchange rate

The following are exchange rates used for the cost estimate.

i) US$ 1.0= Y 118.92
ii) US$ 1.0= Rp. 9,050
(Y 1.0= Rp. 76.1)
where: US$: U.S. dollar;
Y: Japanese yen; and
Rp.: Indonesian rupiah

(3) Currency of cost estimate

Cost is estimated in U.S. dollar.

7.4.2 Cost Component

(1) Project cost

The project cost is composed of the following:

(i) Construction cost,
(ii) Consulting service cost,
(iii) Administrative expenses,
(iv) Land acquisition cost,
(v) Contingencies, and
(vi) Tax and duty

Note:
- Items (i) and (ii) are estimated excluding tax and duty.
- Items (iii) and (iv) are estimated including their related physical and price contingencies, and taxes.
- Item (v) is estimated as the physical and price contingencies for Items (i), (ii) and (iv).
- Item (vi) is tax and duty relating to Items (i) and (ii).
- Items (i), (ii) and (v) will be financed under a loan to be raised by the Government of Indonesia (GOI).
- Items (iii), (iv) and (vi) will be borne by GOI.

(2) Construction cost

Construction cost is composed of; i) cost for sediment storage reservoir works and dredger procurement; and ii) cost for watershed conservation works.

i) Cost for sediment storage reservoir works and dredger procurement

The cost for sediment storage reservoir works and dredger procurement is estimated as the aggregate of the following:

a) Cost for temporary works: 10 % of the major and other works
b) Cost for major works: multiply the work quantities by their unit cost,
c) Cost for other works: 25 % of the major works

ii) Cost for watershed conservation works

The cost for watershed conservation works is estimated by multiplying the quantities of works and material by their unit cost.

Village people would fully participate in the works with their contributing of the following:

Table 7.4.1 Village Labor Contribution for Watershed Conservation Works

Item	a) Earth and stone moving works	b) Planting works, for lip & riser
1. Labor contribution by villagers	25 %	50 %
2. Labor wage rate by project	75 %	50 %

Source: JICA Study Team
Item 2 is used for the project cost estimate.

(3) Consulting service cost

Consulting service cost is estimated at:

- 10 % of construction cost.

The consulting service cost is divided into two categories. One is for the design and supervision for the sediment storage reservoir works and dredger procurement, the other is for the design, preparation and monitoring for the watershed conservation works in the following proportions:

1) 75 % for sediment storage reservoir works, and
2) 25 % for watershed conservation works

(4) Administrative expenses

Administrative expenses are estimated as the aggregate of the following:

- 1.0 % of construction cost.
- Relating physical and price contingencies.

In the same manner as the consulting service cost, the administrative expenses are divided into two categories below.

1) 75 % for sediment storage reservoir works, and
2) 25 % for watershed conservation works

(5) Land acquisition cost

This cost item includes the cost for:

- Land acquisition;
- Compensation; and
- Resettlement.

Compensation and resettlement cost would not be expensed. Land acquisition cost is estimated to allow for the case where a part of the proposed spillway structure might overlap with the existing public road. The estimation is made by multiplying the land area by the prevailing acquisition rate.

(6) Physical and price contingencies

1) Physical contingency

Physical contingency is estimated at 5 % or 20 % of the works depending on the type of works, scale of works, and the accuracy of survey, design and quantity estimates.

2) Price contingency

Price contingency is estimated at the following rates:

- 1.2 % per annum for foreign currency, and
- 3.2 % per annum for local currency

(7) Tax and duty

This item includes:

- Value-added tax (VAT or PPN);
- Customs duty; and
- All other taxes to be imposed in Indonesia.

The value-added tax (VAT) is estimated for the costs of the construction works and the consulting services. The tax rate of 10 % is applied for the computation.

7.5 Estimate of Project Cost

7.5.1 Construction Cost

(1) Price data

Price data on construction equipment and material were obtained through quotations from several construction companies in Indonesia. Major companies were selected so that the prices for a lot of items and quantities for equipment and material could be obtained. The Study Team asked for quotations from the following companies:

- PT. Wijaya Karya
- PT. Waskita Karya
- PT. Trakindo Utama
- PT. Sac Nusantara

Price lists were also obtained for heavy oil (banker) and ready-mixed concrete from the following local suppliers:

- Pertamina
- PT. Jaya Redymix
- PT. Bengawan Readymix

(2) Prices used for estimation

The price data, that is not available through the quotations and the price lists obtained, is added from the 'Journal of Building Construction & Material Price, No. 25, July 2006'. The prices used for the cost estimate are tabulated below:

- Labor wages
- Construction material prices, and
- Construction equipment rate (rental rates)

(3) Unit cost for works

Unit costs for major works are estimated based on the labor wages, material prices, and equipment rental rates. Estimated unit costs are tabulated below:

Table 7.5.1 Estimated Unit Cost for Works

Work item	Unit	Unit cost ($)
1. Steel sheet piling, Type U-III	ton	1,326
2. Excavation, common	m3	4
3. Excavation, forebay	m3	4
4. Backfilling	m3	2
5. Filling, for dike	m3	3
6. Concrete	m3	113
7. Rebar	ton	982

Source: JICA Study Team
Note: - Price level: December 2006

(4) Construction cost

The construction cost is estimated in Table 7.5.2.

7.5.2 Project Cost

Consulting service cost, land acquisition cost and administrative expenses are estimated as shown in Tables 7.5.3 to 7.5.5. Table 7.5.6 presents the project cost. Operation and maintenance cost is estimated in Table 7.5.7. Total project cost was estimated US$ 76.3 million excluding tax.

CHAPTER 8 PROJECT EVALUATION

8.1 Methodology

Viability of the proposed urgent countermeasures (the Project) is determined from the economic evaluation. The economic evaluation is conducted in terms of the Economic Internal Rate of Return (EIRR) and cost benefit analysis (B-C) on the basis of the economic cost and benefit. The same methodology in the Master Plan Study is applied to the project evaluation in the Feasibility Study.

8.2 Economic Cost Estimate

The conversion factors are used to transform the financial prices into economic prices. As the economic evaluation is done from the point of view of the national economy, the conversion factors serve to eliminate distortions in the financial prices, such as taxes, subsidies, price controls, transfer payments, etc. The estimated economic cost of the Project is shown in Table 8.2.1. Table 8.2.2 shows the details of the economic cost estimation for the watershed conservation project in the Keduang River basin.

8.3 Economic Benefit Estimate

(1) Types of Benefit

Economic benefits of the Project are generated from: i) securing the Wonogiri reservoir function and ii) conserving the Wonogiri watershed. The former is expected to extend the reservoir lifetime for providing flood protection benefit, hydropower benefit and irrigation benefit. The latter is expected to bring benefit through an increase in agricultural production.

(2) Benefit of Extension of Reservoir Useful Life

The incremental benefits are the difference between the benefits under “with project” condition and “without project” condition. The conceivable benefits are accrued from prolonging the useful life of the reservoir.

For downstream incremental benefits of “without project” condition assumes that when the reservoir sub-area for the Keduang River is completely filled with sediments in the year 2022, the function of the Wonogiri dam for providing irrigation and domestic water supply will cease from 2022. The “with project” condition assumes progressive decrease of the effective storage of the reservoir, reaching 28% of the original capacity after 50 years. The progressive decrease of the effective storage will cause a proportional decrease of the annual benefits from the Wonogiri reservoir. However, there is no extra flood mitigation benefit because no sedimentation will occur in the flood control zone of the reservoir and therefore the flood control function will be secured for the coming 100 years.

The process for estimating benefits is described in subsection 11.6.3 in Part I: Master Plan Study.

(3) Benefit of Watershed Conservation in the Keduang Catchment

Benefit from the Watershed Conservation Project area is estimated as the difference between net return from crops of the “with project” condition and net return from crops “without project” (current condition). The benefit is estimated over 15 years and afterwards it is assumed to be as same as that of the 15th year. Benefits from the

agro-forestry crops are calculated from the average value of 6 crops such as mango, durian, rambutan, cashew nut, clove and cacao.

The benefit is estimated based on the following procedure:

i) Calculation of net return of crop/ha by preparing crop budgets/ha for each crop in the conditions of with and without project conditions

ii) Calculation of net return/ha for each upland based on five slope classes and cropping pattern/cropping intensity in the conditions of with and without conditions

iii) Calculation of total net return of the total net area in with project condition and without condition

iv) Calculation of benefit as difference between total net return in with project condition and without condition

Economic benefit is estimated on the basis of border parity prices for farm inputs such as urea, TSP and KCL and a shadow price (0.75) for unskilled labor. Total economic benefit from the Keduang Watershed Conservation Project from 1st development year to 15th development year is estimated as shown in Table 8.3.1 and summarized below.

Table 8.3.2 Total Economic Benefit from Keduang Watershed Conservation Project

Slope Classification	Benefit (Rp.million)		
	1st – 4th year	5th – 10th year	11th – 15th year
0-8%	648~857	768~1,261	1,335~1,395
8-15%	231~1,222	700~2,891	3,282~3,543
15-25%	-1,183~-187	225~3,307	3,288~4,221
25-40%	-1,013~178	624~3,362	3,596~4,174
Over 40%	-2,551~-471	892~5,541	5,498~6,918
Total Benefit	**-594~2,615**	**2,524~9,669**	**10,175~11,819**

Source: JICA Study Team

8.4 Economic Evaluation for the Project

(1) Assumptions

The following assumptions are applied to the economic evaluation.

Price level and exchange rate:

The analysis is done using the price level of December 2006, and applying the following exchange rates:

1 US$ = 9,050 Rp. 1 JPY = 76.1 Rp. 1 US$ = 118.9 JPY

The costs and benefits are estimated according to local conditions and expressed in US$.

Project life:

The project life is to be 50 years after the implementation. The residual value of the facilities at the end of the project life is neglected.

Discount rate:

A discount rate of 12%, which is applied for the similar projects in Indonesia, is adopted.

(2) Result of Economic Evaluation

The result of evaluation for the project is expressed in IRR (%) and net present value

(B-C) as given in Table 8.4.1. The project is considered to be economically feasible due to the positive value of B-C and 12% or higher EIRR, based on the discount rate of 12%.

The comparison of economic costs and benefits of the Project gives an EIRR of 16.9%. That is 4.9 percentage points above the discount rate (12%), which is considered an acceptable rate of return for projects in Indonesia. Therefore, the Project is considered to be highly effective.

CHAPTER 9 PROJECT IMPLEMENTATION

9.1 Implementation Program

The overall implementation schedule for the Project is presented in Table 9.1.1 below:

Table 9.1.1 Overall Implementation Schedule of the Project

Major Work Item	Year						
	2007	2008	2009	2010	2011	2012	2013
1 Financial Arrangement							
2 Sediment Storage Reservoir							
Detailed Design							
PQ and Tender							
Construction							
3 Watershed Conservation in Keduan Catchment							
Socialization and Planning							
Implementation							
Supporting Program							
4 Procurement of Dredger							
Design							
Manufacturing							
Installation							

Source: JICA Study Team

The Project should preferably be commenced as early as possible to keep proper function of he the existing intake. It is envisaged that the funding source for the design and implementation may be a loan from JBIC or international assistance funds available. Implementation of the Project will require a total period of 4.5 years from the commencement of detailed engineering for the structural measures. The construction works will require 2.5 years for the sediment storage reservoir, one year for procurement of dredger and 4 years for watershed conservation. The watershed conservation works will be split into two sub-watersheds (around 5,500 ha each) considering the past experience on a similar project by IBRD from 1988/89 to 1994/95. The watershed conservation works for each sub-watershed will take totally 3 years; one year for the socialization and planning, and subsequently two years for implementation. The support program will carry on during the whole period.

9.2 Executing and Implementation Agencies

The executing agency at a national level for implementing the Project will be the Directorate General of Water Resources (DGWR) of the Ministry of Public Works (MPW). The MPW is responsible for execution of the Project. At the site level, the Bengawan Solo River Basin Development Project (PBS)[1] will act as the implementing agency.

9.3 Project Management Organization

The diagram below outlines the proposed project management organization down to district level to implement the Project. The proposed organization at field and village levels for the watershed conservation activities is discussed in succeeding Section 9.4.

[1] This project organization was absorbed by the new Balai Besar Wilayah Sungai Bengawan Solo.

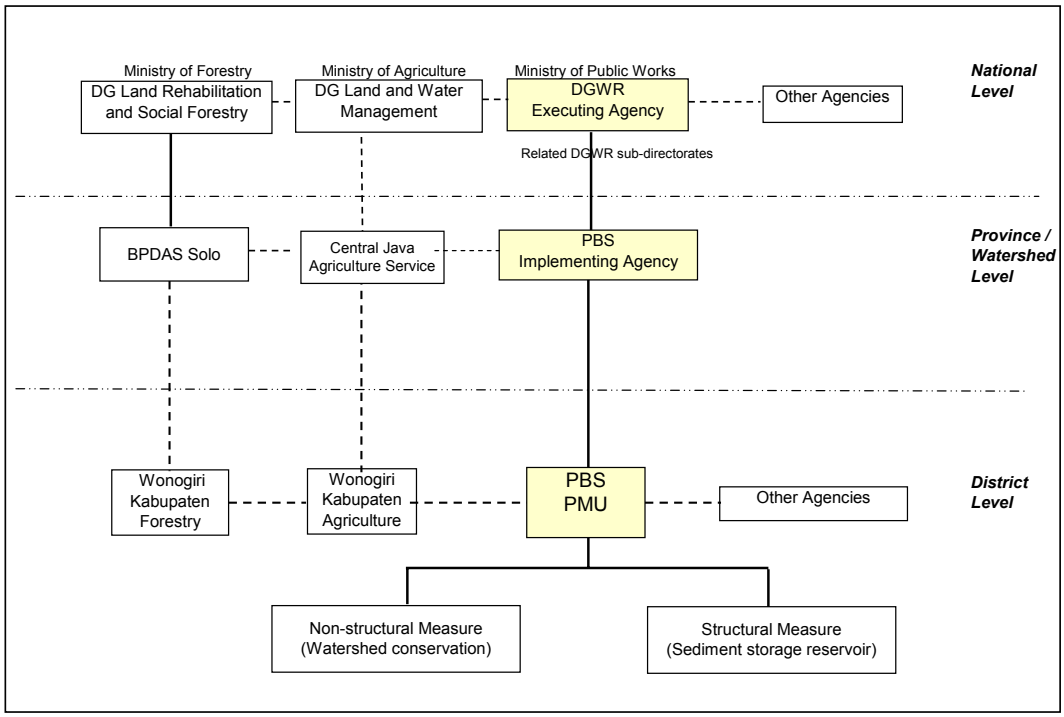


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Figure 9.3.1 Project Management Organization

The DGWR as the executing agency would be assisted by related agencies such as BAPPENAS, Ministry of Forestry, Ministry of Agriculture, and Ministry of Home Affairs. The Directorate General of Land Rehabilitation and Social Forestry of Ministry of Forestry would exercise overall control of forestry activities through BPDAS Bengawan Solo. The Directorate General of Land and Water Management of Ministry of Agriculture would support the agricultural activities through the Central Java Agriculture Service. This would be done in accordance with the Memorandum of Understanding (MOU) described below.

At the outset, the MOU should be signed by Directorate General level agencies from the Ministries of Forestry, Agriculture and DGWR agreeing to overall project management by DGWR/PBS on the terms specified in the MOU. This agreement would then be made known to Central Java Province and Kabupaten Wonogiri forestry, agriculture and public works services.

The DGWR would establish a Project Management Unit (PMU) at the district level. The PMU will be under the direct control of PBS as the implementing agency and would be responsible for the day-to-day supervision and coordination of the two constituent projects; construction of the sediment storage reservoir and watershed conservation works.

These projects would be managed as follows:

i) The construction of sediment storage reservoir is under direct management of PBS. The representative from PBS should be in the PMU.

ii) The PMU consists of agencies relating to watershed conservation and management activities in the Wonogiri catchment; such as forestry service and agriculture service of Kabpaten Wonogiri, Bappeda Kabupaten Wonogiri, BPDAS Solo, BP2TPDAS, PJT I Bengawan Solo, KPH Surakarta of State Forestry Corporation, etc.

iii) The PMU is responsible for; a) supervision of implementation, b) coordination with the implementation committees to be established at village level (described in Section 9.4 below), and c) operation of the project fund.

iv) The funding assistance for the Wonogiri dam beneficiaries (see Chapter 11) would, if the Study team recommendations are adopted, require the mobilization of a more detailed feasibility study. This should be managed by PBS with the support of DGWR, Kabupaten Wonogiri and Central Java Provincial Government.

v) A Steering Committee should be established at the national level. The Steering Committee will comprise senior officials from central government agencies concerned with the projects to be implemented and will provide overall supervision for the project activities.

9.4 Organization Set-up for Watershed Conservation Activities at Field and Village Levels

(1) Organizational Structure

In the objective watershed area, the farm holding size is limited and measures for watershed conservation would become dispersed with limited effect if the measures were to be introduced individually by interested farmers. Therefore, a community based introduction of the measures is envisaged with a number of small-scale farmers having a mutual understanding and agreement on the proposed measures. Local people will be the most important factor in good watershed conservation and management. For the implementation of conservation, it is essential that the communities at a field and village level take a responsible role for the proposed watershed conservation activities from the planning stage and in collaborative activities of all stakeholders, communities and implementing agencies.

The proposed implementation arrangement at field and village levels, therefore, should be initiated with an "implementation committee" to be established at village level as shown in Figure 9.4.1. The implementation committee is responsible for; i) supervision of all the conservation works and activities in the village, ii) coordination with PMU and agencies concerned, and iii) operation of the village grant fund. The members of the implementation committee should be selected with transparency in the beginning of the implementation under the guidance and support of the Project Management Unit (PMU) or the Supporting Team (consists of consultants and NGO) or both.

As shown in Figure 9.4.1, formation and empowerment of beneficiaries or practitioner groups, Kelompok Konservasi Tanah dan Air (K2TA; Soil & Water Conservation Farmer Group) will also be formulated at the field level. Such formation and empowerment guidance is to be executed within the year prior to the implementation of the conservation measures. The K2TA is responsible for; i) terrace improvement/upgrading and formation, ii) agro-forestry development, iii) monitoring and evaluation, and iv) supporting program for community development.

(2) Role and Responsibility amongst Stakeholders at Village Level

To avoid confusion amongst stakeholders, the individual roles and responsibilities should be defined. The roles and responsibilities should be finalized in the workshops with consent amongst the people. However, the tentative roles for each component are as follows:

Table 9.4.1 Role of Stakeholders Concerned

Component	Executor	Supervisor	Supporter
(1) Terracing	K2TA	Implementation Committee	Extension staffs (PPL/PKL) and PMU
(2) Village Grant Fund	Village people	Implementation Committee	PMU and Support Team
(3) Monitoring & Evaluation	K2TA	Implementation Committee	PMU and Support Team
(4) Support Programs for Soil & Water Conservation Measures	Extension staffs (PPL/PKL) and Consultant	Implementation Committee	PMU
(5) Support Programs for Land Management & Agricultural Promotion Measures	Support Team	PMU	-
(6) Support Programs for Community Development	K2TA and other village organizations	Implementation Committee	PMU and Support Team

Note; PPL: Agricultural field extension worker, PKL: Forestry field extension worker, PMU: Project Management Unit
Source: JICA Study Team

Based on the above role of each organization concerned, the tentative responsibility of each stakeholder will be as follows:

Table 9.4.2 Responsibility of Stakeholders Concerned

Stakeholders	Responsibility
Farmers	Operation and maintenance of individual land
K2TA	Terracing, terrace improvement and upgrading
Implementation Committee	Supervision of all work, coordination with PMU, and operation of village grant fund
Extension staffs (PPL/PKL)	Technical training and guidance to K2TA
Consultant	Technical training and guidance to extension staff
Project Management Unit	Supervision of project implementation, coordination with Implementation Committee, and operation of project fund

Note; PPL: Agricultural field extension worker, PKL: Forestry field extension worker, PMU: Project Management Unit
Source: JICA Study Team

CHAPTER 10 OPERATION AND MAINTENANCE PLAN

10.1 Organizational Reform for Balai Besar Wilayah Sungai

10.1.1 Background

The Ministry of Public Works (MPW) decided to consolidate several water resources management implementing organizations, including river basin development, flood control and coastal protection projects and Jasa Tirta Public Corporations (PJTs), into one water resources managing institution for each major river basin. Such institutions were named, Balai Besar Wilayah Sungai (River Basin Office). Similar institutions for smaller less developed river basins would be known as Balai Wilayah Sungai.

The organization and management of Balai Besar Wilayah Sungai is set out in MPW Regulation No.12/PRT/M/2006, although there is little on the subject of management and relations with other water resources management bodies or other parts of DGWR. The Balai Besar Wilayah Sungai (BBWS) is a technical implementation unit (TIU) under and reporting to the DGWR through the Directorate of Rivers, Lakes and Reservoirs. The BBWS is responsible for implementing water resources management as well as O&M works in major river basins. This work includes "planning, implementation of construction, operation and maintenance in the framework of conservation of water resources, development of water resources, efficiency of water resources, and control of water disasters" in a river basin.

The background and reasons for this organizational reform are as follows:

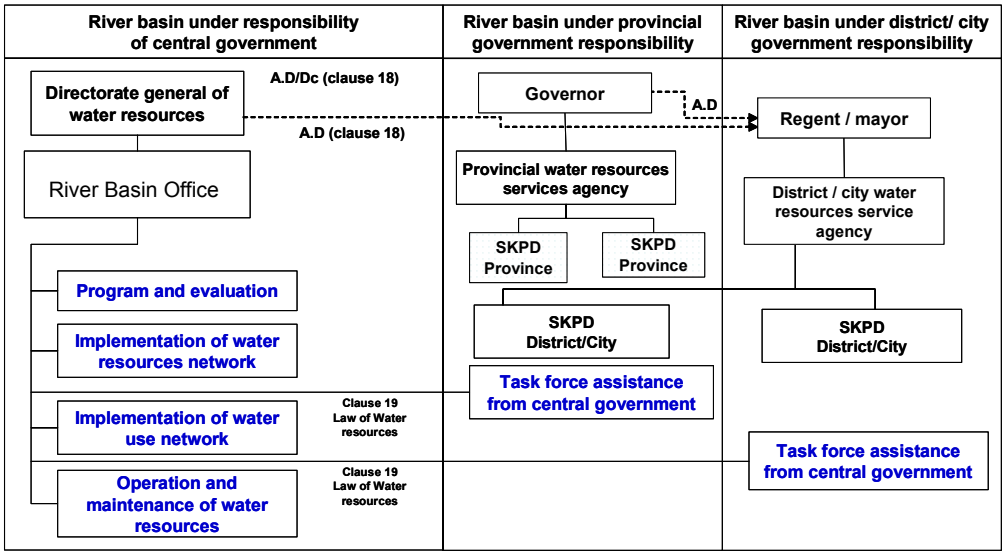
i) The actual records on management of PJT I and PJT II revealed that their revenues from water tariffs could cover only 45% or less of the required total expenditures for O&M of water resources facilities, thereby making it difficult to carry out the sufficient O&M works. To improve such situation, a new organization needed to be established to perform the appropriate O&M with the financial support of the Central Government.

ii) The present PJTs are under the control of different ministries. PJTs are institutionally under the control of the Ministry of State-Owned Corporations, while technically under the MPW. The suggested organizational reform aims at carrying out the O&M under one ministry, namely the MPW.

iii) At present, the regional organizations of the MPW are allowed to continue to exist until the end of the project implementation. The State Finance Low No. 17/2003 stipulates that the project-oriented regional offices will have to be abolished, leaving only the regional organizations with regular services and obligations.

Figure 10.1.1 shows the organizational structure of Balai Besar Wilayah Sungai. As shown, TIUs at national and provincial levels can provide assistance to provincial and kabupaten water resources services, if requested. In addition, provincial and kabupaten water resources services can undertake tasks (if they agree) for national[1] and provincial governments respectively, for which they would be compensated financially.

[1] Via de-concentration from national level to provincial governor.



Notes: The status of Technical Implementation Unit (TIU) in each central, provincial and kabupaten/kota (district/city) government is:
(1) Provincial Govt Working Unit (SKPD Prov.) is the TIU under Provincial Water Resources Services with its working area in the related river basin. For example, the working area of SKPD Porong is in the Porong River basin
(2) Kabupaten/Kota Government Working Unit (SKPD Kab./Kot.) is the TIU under Kabupaten/Kota Water Resources Services with its working area in the related river basin.
Abbreviations: A.D. = Assistance Task; Dc = deconcentration; Clauses are from the WR Law 7/2004

Source: DGWR

Figure 10.1.1 Balai Besar Wilayah Sungai in Government Structure on Water Resources Management

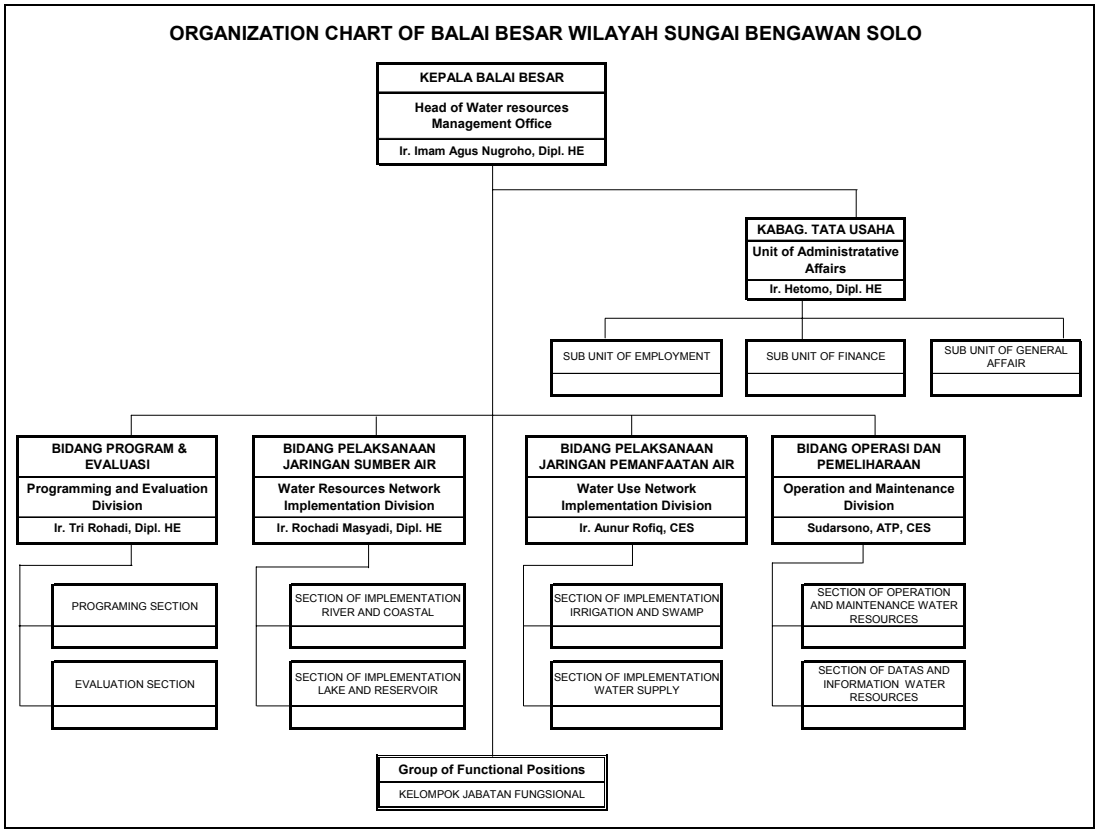
10.1.2 Establishment of Balai Besar Wilayah Sungai Bengawan Solo

It was expected that the MPW would begin to implement the new structure in 2007, after completing the necessary budgeting procedure and providing an explanation to the concerned local governments from October to December 2006. Senior staff have already been appointed to BBWS throughout Indonesia via MPW decrees numbered 384/2006, 385/2006 and 386/2006 issued in November 2006.

In the Bengawan Solo River basin, the current organization structure of PBS was changed and the Balai Besar Wilayah Sungai Bengawan Solo was established in January 2007. The organization structure of Balai Besar Wilayah Sungai Bengawan Solo is shown in Figure 10.1.2.

The BBWS Bengawan Solo comprises divisions for programming and evaluation, implementation of water resources network (with a river & coast section; swamp & reservoir section), implementation of water use network (with an irrigation section; raw water section), and operation and maintenance (with sections for O&M of water resources; data and information). There are the usual administration unit and expert group.

It is said that, in the longer term, MPW intends to absorb PJT I into the BBWS Brantas and BBWS Bengawan Solo. During an initial period, probably at least three years, BBWS Bengawan Solo would work in parallel with PJT I Bengawan Solo, while absorbing projects and taking over some O&M works. Therefore at moment, PJT I Bengawan Solo is responsible for O&M of the Wonogiri dam and reservoir.



Source: Balai Besar Wilayah Sungai Bengawan Solo

Figure 10.1.2 Organization Structure of Balai Besar Wilayah Sungai Bengawan Solo

10.2 Definition of Operation and Maintenance Works

The urgent countermeasures proposed in the Master Plan comprise of; i) construction of a sediment storage reservoir with new gates, ii) watershed conservation works in the Keduang River catchment, and iii) procurement of a dredger for periodic maintenance dredging at the existing intake. Management and care of the facilities will be required after completion of the above construction works. This is known as O&M works. These activities are generally defined as follows:

Operation works	:	Various activities for fully utilizing the sediment storage reservoir and dredger for sustaining the function of Wonogiri reservoir
Maintenance works	:	Various activities for full care of the above facilities so that they can function as designed

Both works above should be carried out continuously and supported by adequate budget, skilled personnel and appropriate equipment for satisfactory execution of both works. During the detailed design stage or the construction and supervision stage, an operation and maintenance manual will be prepared to cover detailed activities for O&M as well as the operation rules for sediment storage reservoir. In this section, general concept of O&M is described with the main focus on the operation of the sediment storage reservoir.

The local farmers should independently carry out the operation and maintenance works of the watershed conservation area. Periodic public consultations would be a good

opportunity to empower local farmers in understanding the importance of sustainable maintenance of cultivated lands. It is generally said that the watershed conservation area is likely to re-deteriorate without good maintenance by local farmers. Since the soil erosion rate in the watershed conservation area (cultivated farmlands) should be maintained at the design level, it is indispensable that there be long lasting locally budgeted maintenance works. This should be allowed for under the funding framework that transfers some of the benefit from the downstream stakeholders of the Wonogiri dam to the upstream ones.

10.3 Operation Works of Sediment Storage Reservoir

The Wonogiri reservoir will be divided into two reservoirs by the closure dike; a sediment reservoir and the Wonogiri main reservoir. As shown in Figure 3.1.4, the storage capacity of the sediment storage reservoir is as small as around 11 million m^3 at CWL 135.3 m. Both reservoirs are to be operated independently. The current reservoir operation rules of the Wonogiri dam are unchanged and thus will be applied to the operation of Wonogiri main reservoir as summarized below:

Table 10.3.1 Reservoir Operation Rules

Definition	Wonogiri main Reservoir	Sediment Storage Reservoir
1. Period (Article 3) Flood Non-flood Recovery	 December 01 to April 15 May 01 to November 30 April 16 to April 30	 December 01 to April 15 May 01 to November 30 April 16 to April 30
2. Flood discharge (Article 2)	Inflow discharge exceeding 400 m^3/s	Inflow discharge exceeding 400 m^3/s
3. Water Level in Flood Period (Article 13)	Maintain CWL 135.3 m, Flood control capacity (El. 135.3 m – El. 138.3 m)	Maintain CWL 135.3 m, Flood control capacity (El. 135.3 m – El. 138.3 m)
4. Water Level in Non-Flood Period (Article 13)	Draw down of El. 127.0 m – El. 136.0 m, water use capacity for irrigation and hydropower	Draw down of El. 127.0 m – El. 136.0 m, water use capacity to the main reservoir thru the connecting conduit

Note: Article Number is from Manual for Operation and Maintenance, February 1984

Source: JICA Study Team

The operation of sediment storage reservoir is divided into two operations; that is, i) ordinary operation and ii) flood control operation. Main points of their operations are briefly described below:

10.3.1 Ordinary Operation of Sediment Storage Reservoir

The sediment deposits from the Keduang River in the sediment storage reservoir will be released by use of the stored water and inflow from the Keduang River without using the stored water in the Wonogiri main reservoir. The reservoir water level at the main reservoir will be maintained without lowering when the sediment release operation is carried out at the sediment storage reservoir. It is however noted that sediment release from the sediment storage reservoir can only be conducted when the water level of the Wonogiri main reservoir exceeds NHWL 136.0 m so that excess water is available.

Ordinary operation of the sediment storage reservoir is briefly as follows:

a. In the beginning of wet season (November to December):

Inflow from tributaries is stored in both the Wonogiri main reservoir and sediment storage reservoir. The inflow from the Keduang River is fully stored in the sediment storage reservoir. Sediment inflow from the Keduang River is also deposited in the sediment storage reservoir. The reservoir outflow is for hydropower generation from the main reservoir. New gates in the sediment storage reservoir are closed as illustrated below.

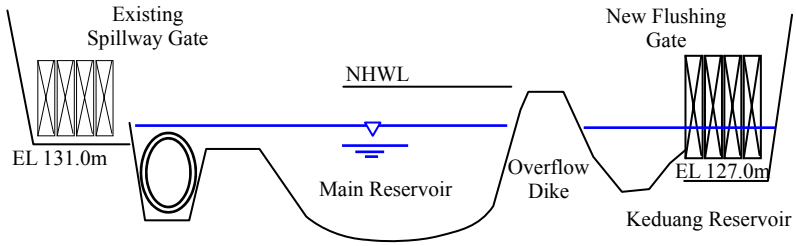


Figure 10.3.1 Illustration of Operation of Sediment Storage Reservoir (1/3)

b. In the middle of wet season (December to January):

Because of very small capacity of the sediment storage reservoir, the water level thereof rises rapidly according to the flood inflow from the Keduang River. When the water level of the sediment storage reservoir exceeds the crest of overflow dike, the stored water in the sediment storage reservoir overflows into the Wonogiri main reservoir as illustrated below.

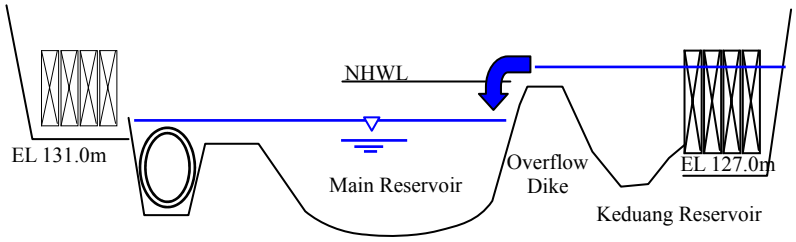


Figure 10.3.1 Illustration of Operation of Sediment Storage Reservoir (2/3)

c. At the end of wet season (February to April):

If the water level in the Wonogiri main reservoir portion reaches CWL 135.3 m, water storing will be secured. When a flood occurs in the Keduang River, the new gates will be opened to pass through the sediment inflow without deposition inside the reservoir. On the other hand, when water level in the Wonogiri main reservoir exceeds NHWL due to flood inflow from other tributaries, the stored water overflows adversely, over the overflow dike, into the sediment storage reservoir as shown below. When excess water is available, all the excess water will be released through the new gates instead of the existing spillway until the end of wet season (on April 15).

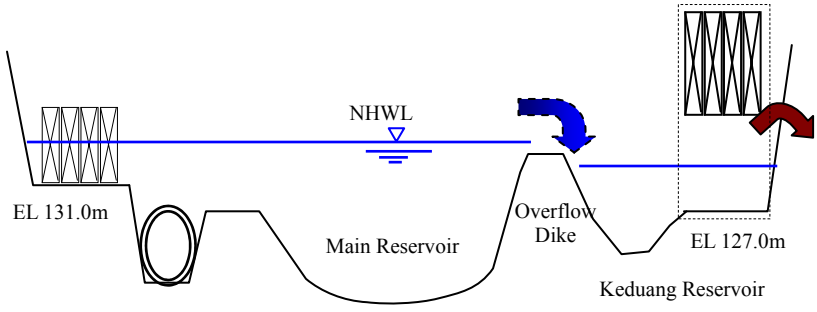
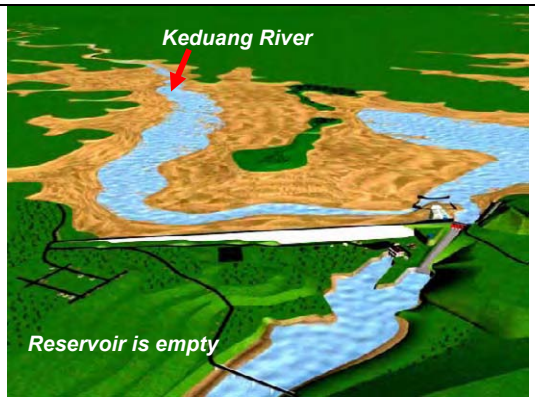
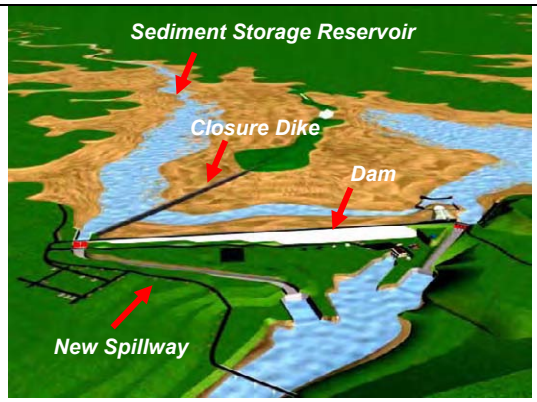
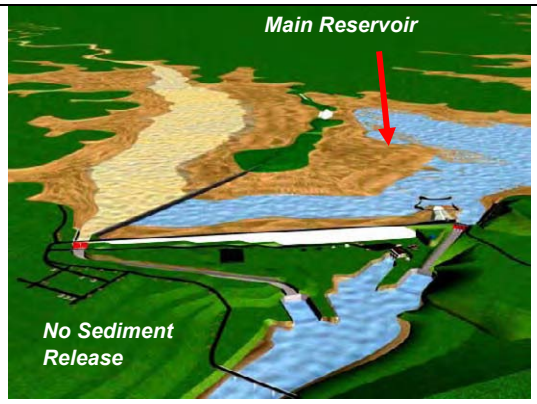
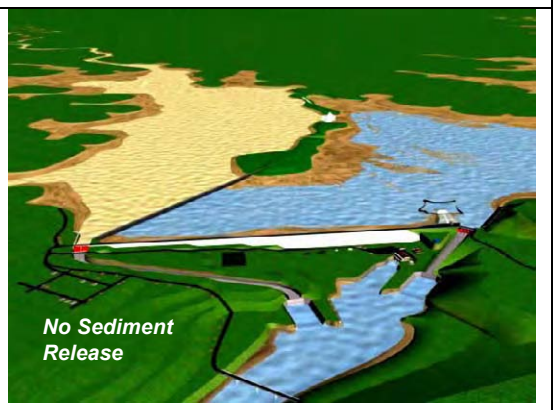
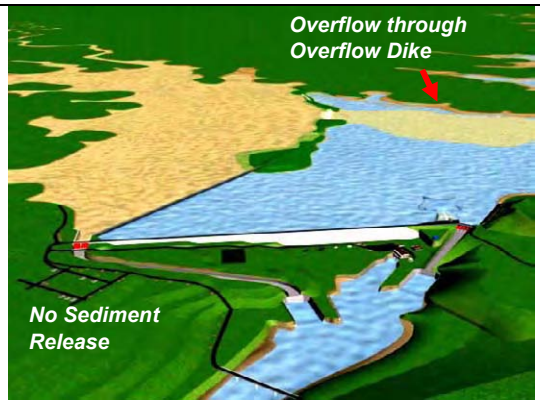


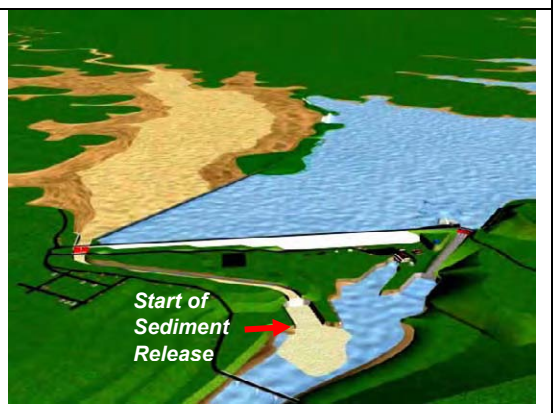
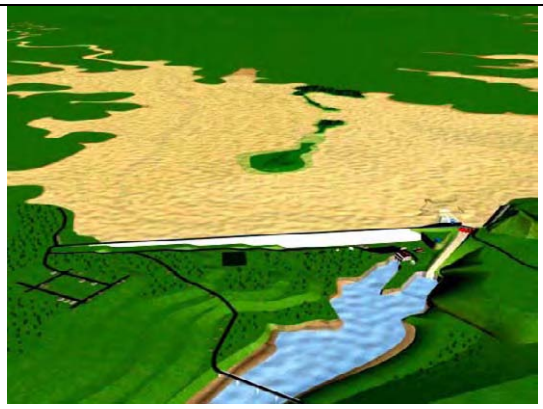
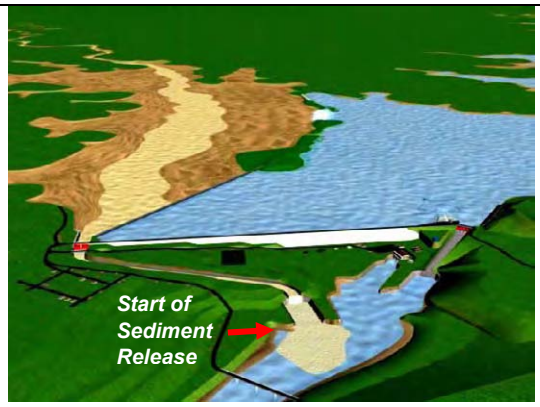
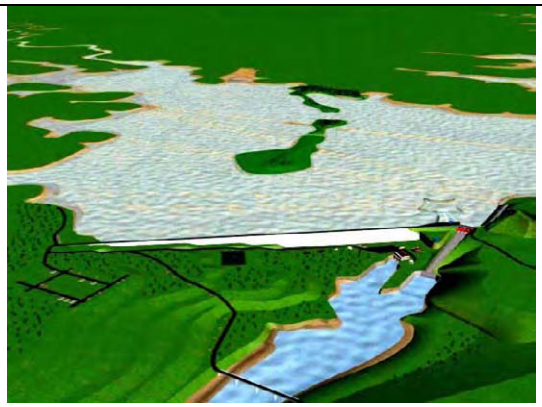
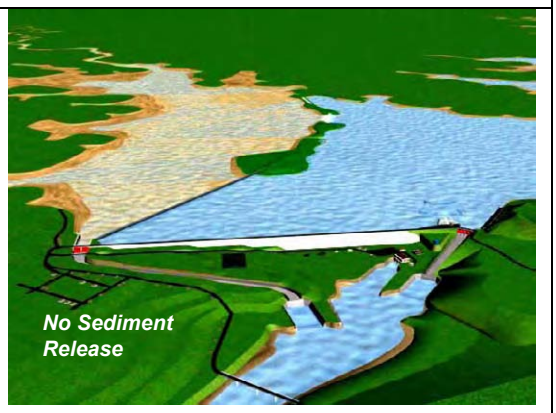
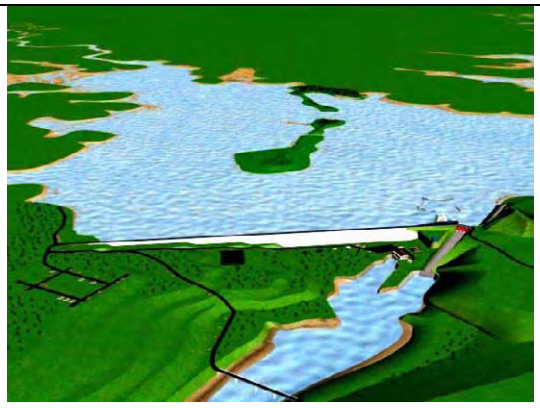
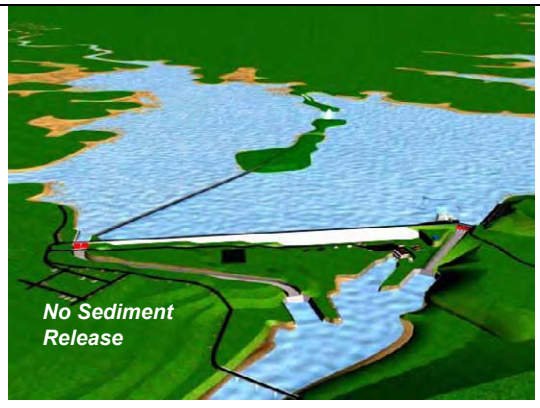
Figure 10.3.1 Illustration of Operation of Sediment Storage Reservoir (3/3)

Figure 10.3.2 illustrates typical operation of the sediment storage reservoir and Wonogiri main reservoir compared to the current operation of Wonogiri reservoir.

Month	Present Operation of Wonogiri Reservoir	Operation of Sediment Storage reservoir
Oct. *End of Dry Season*		
Nov. *Begininng of Wet Season*		
Dec.		
Jan.		

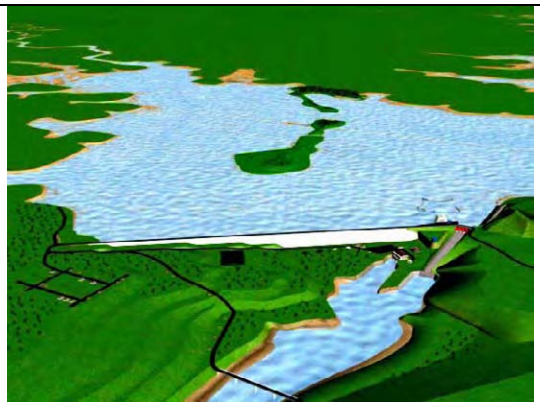
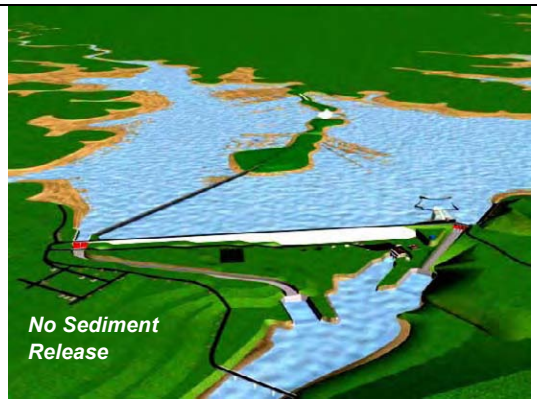
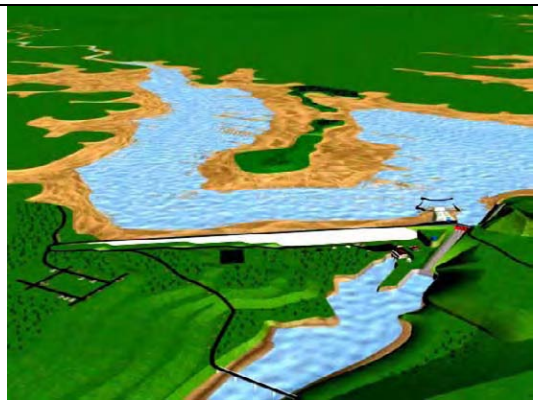
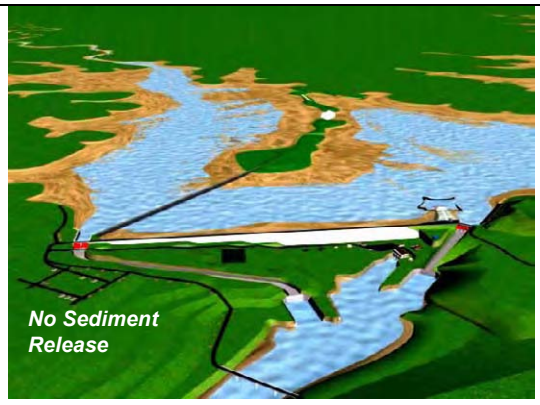
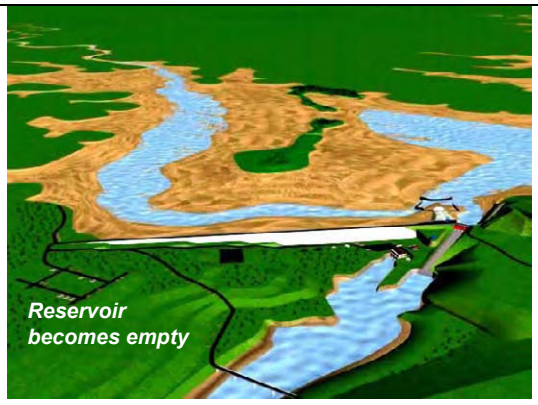
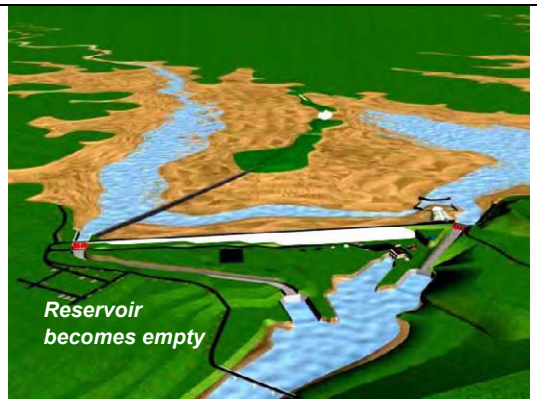
Source : JICA Study Team

Figure 10.3.2 Illustration of Monthly Operation of Current Wonogiri Reservoir and Sediment Storage Dam (1/3)

Month	Present Operation of Wonogiri Reservoir	Operation of Sediment Storage reservoir
Feb.		
Mar.		
Apr. *End of Wet Season*		
May. *Beginning of Dry Season*		

Source : JICA Study Team

Figure 10.3.2 Illustration of Monthly Operation of Current Wonogiri Reservoir and Sediment Storage Dam (2/3)

Month	Present Operation of Wonogiri Reservoir	Operation of Sediment Storage reservoir
Jun.		
Jul.		
Aug.		
Sep. End of Dry Season		

Source : JICA Study Team

Figure 10.3.2 Illustration of Monthly Operation of Current Wonogiri Reservoir and Sediment Storage Dam (3/3)

10.3.2 Flood Control Operation of Sediment Storage Reservoir

To eliminate the possibility of overtopping by the probable maximum flood (PMF) on the Wonogiri dam crest, the reservoir water level will be controlled not to exceed the CWL 135.3 m during the flood period between December 1 and April 15 (see Table 10.3.1 above). The Wonogiri reservoir still has a flood control space of 220 million m^3 to regulate the standard highest flood discharge (SHFD) with a peak discharge of 4,000 m^3/s. When the SHFD occurs, the spill-out discharge from the spillway is controlled through the spillway gate operation to keep an constant outflow of 400 m^3/s during the flood.

As verified by the flood routine calculation in Section 3.1, the sediment storage reservoir facilities are designed to secure the flood control function of the Wonogiri reservoir with only minor modification of the current rule for flood control operation as follows:

Table 10.3.2 Design Reservoir Water Levels and Maximum Outflows

Design Flood	Peak Inflow (m^3/s)	Wonogiri Main Reservoir		Sediment Storage Reservoir	
		Design RWL (EL. m)	Max. Outflow (m^3/s)	Design RWL (EL. m)	Max. Outflow (m^3/s)
Standard Highest Flood Discharge	4,000	137.7	0	137.7	400
Spillway Design Flood	5,100	138.3 (DFWL)	0	138.3 (DFWL)	1,140
Probable Maximum Flood	9,600	139.1 (Extra FWL)	1,360	139.1 (Extra FWL)	1,270

Note: Results of flood routing calculation are detailed in subsection 3.1.6.
Source: JICA Study Team

As shown above, the original design flood water levels such as DFWL and Extra FWL are unchanged. The design outflow discharges against the Standard Highest Flood Discharge and Spillway Design Discharge are merely changed from the existing spillway to the new spillway in the sediment storage reservoir. As for the PMF, gates at both spillways will be fully opened from the dam safety viewpoint. The maximum water levels are EL. 138.61 m in the sediment storage reservoir and EL. 138.95 m in the Wonogiri main reservoir. Both maximum water levels are below the design Extra FWL of 139.1 m.

10.4 Maintenance Works of Sediment Storage Reservoir

Maintenance works are broadly divided into two sub works; i) Preventive maintenance and ii) Corrective maintenance (repair works, rehabilitation works). The preventive maintenance work comprises all activities to be carried out to maintain optimal function of the facilities. The corrective maintenance is called asset renewal that includes emergency maintenance works, rehabilitation work, repair work, upgrading work, etc.

The preventive maintenance work is further divided into the following two categories in terms of frequency of the work:

Routine maintenance : All repetitive works that is carried out on a cycle basis with the planned frequencies, e.g. cleaning of structures, removal of garbage and debris, gate painting, etc. Usually this work is of a small scale, not labor intensive and is conducted several times per year or annually.

Periodic maintenance : Works that is required from time to time at intermittent intervals for preserving the intended use of facilities. Usually this work is of medium size and often labor intensive and conducted once a year or every few years. This work also includes some

small-scale repair works necessary for the restoration of facilities in occurrence of minor damage and failure.

The corrective maintenance works is usually a medium to large-scale repair or rehabilitation works. Such works are varied and let out on a contract basis with special financial assistance, either partly or wholly, from central government as an urgent repair or rehabilitation project. Therefore, the preventive maintenance works, i.e. routine maintenance works and periodic maintenance works, shall be preferably carried out by PJT I Bengawan Solo under the annual budget for O&M works.

10.4.1 Routine and Periodic Maintenance Works

A major part of the routine maintenance is the patrol and inspection that needs to be scheduled. The proposed frequency and timing are proposed as follows:

i) During the dry season: once a month
ii) During the wet season: once a week
iii) During the occurrence of flood: several times a day or as required

As for the sediment storage reservoir, routine inspection should be made on the following items:

i) New gates
   - Leakage at gate guide and gate sill portions
   - Damage on gate leaf, hoist equipment
   - Lubricating of hoist equipment and other movable parts
   - Control equipment and power source
   - Drifting garbage and debris

ii) Civil structures such as spillway, gate, overflow dike, closure dike
   - Cracks on concrete and slope pavement, leakage of water or piping, cave-in, and other damage on embankment
   - Erosion and scouring of embankments
   - Slope failure of embankment
   - Harmful human acts
   - Blocking of connecting conduit due to sedimentation or garbage

ii) Reservoir area
   - Sliding of surrounding slope
   - Deformation and sliding of sub-dam slope
   - Falling of rock riprap of sub-dam
   - Drifting garbage and debris

Through inspection, the facilities/places where the maintenance and repair works are required can be identified and an inventory prepared so the works can be conducted, preferably in the dry season. When large-scale maintenance and repair works are required, the execution program should be arranged taking into account the budget allocation for the work. If any damages are found on the facilities, repair works should be immediately undertaken to prevent further extension or progress of the damages. All of the information obtained through the patrol and inspection should be reported to the head of PJT I

Bengawan Solo with the form of an inspection report. The report should describe, but not be limited to, the necessary works to be repaired with cost estimation as well as site photos.

Besides, there is still a possibility that some garbage from the Keduang River through the overflow dike and/or previously deposited garbage may drift down to the intake. In this respect, it is recommended that periodic maintenance dredging be conducted by PJT I Bengawan Solo in the forebay area of the intake to cope with extreme situations of sediment and garbage inflow. The dredging shall be operated by a dredger aiming at annual suction amount of around 100,000 m^3/year. The sediment management plan in the forebay area of the intake is detailed in Supporting Report I Annex No.5, Section 5.3.

10.4.2 Periodic Monitoring of Sediments

(1) Monitoring of Sediment Inflow

The Wonogiri watershed is drained by six major rivers; Keduang, Tirtomoyo, Temon, Bengawan Solo, Alang Rivrs and Wuryantoro Rivers. Most of the annual sediment inflow comes from the five rivers other than the Wuryantoro River. Although water level records were available at 3 stations, accuracy of data was poor. Under the JICA Study, water level observation, discharge measurement during floods and sampling of sediment loads were carried out at these five rivers to estimate the annual sediment inflow volume from these tributaries. Future annual sediment inflow varies year by year and is highly dependent on the future rainfall amount and intensity, which are also variable by duration and location. If extreme an event occurs, significant volumes of sediment will flow into the Wonogiri reservoir. In this respect, it is vital that monitoring of sediment inflow is continued.

(2) Monitoring of Sediment Deposits in the Wonogiri Main Reservoir and Sediment Storage Reservoir

It is forecast that if watershed management and conservation works are properly undertaken, the reservoir sedimentation rate will be effectively reduced through mitigation of sediment yield in the upper catchment. It is recommended that the reduction in sediment yields be monitored through the reservoir sedimentation survey. In this respect, the periodic surveying of both reservoirs should be continued, preferably every 2-3 years. The periodic reservoir survey will enable an estimate the sediment volume deposited in the reservoir at an interval of 2-3 years.

(3) Monitoring of Sediment Deposits at Intake

PJT I Bengawan Solo is implementing periodic monitoring of the sediment levels on the approach channel of the intake structure. Although it is expected that the problem on blocking of the intake structure will be resolved by the construction of the sediment storage reservoir, periodic monitoring of the sediment deposits in front of the intake should be continued, preferably every two months during the wet season.

(4) Monitoring of Water Quality in the Bengawan Solo River

Water quality monitoring including SS concentration should be continued on a monthly basis along the Bengawan Solo River. The locations are at the bridge below the Wonogiri dam, Colo weir, Jurug, Tangen, Kajangan and Ngawi (confluence to the Madiun River). When sediment release is carried out from the sediment storage reservoir, hourly measurements should be conducted at these monitoring locations. The observed data would be used for establishment of optimal operation rules for the sediment storage reservoir in the future, in order to minimize the impacts on the river environment due to sediment releasing.

CHAPTER 11 INSTITUTIONAL STRENGTHENING FOR WATERSHED MANAGEMENT

11.1 Introduction

In the stage of master plan formulation, the institutional study set out eleven institutional recommendations to address a number of identified issues (see Annex No.11: Institutional Study for Watershed management). From these, three groups have been selected as most suitable for the feasibility study, and also required detailed prior discussion with the relevant stakeholders:

i) Funding assistance from Wonogiri dam beneficiaries for watershed conservation activity in the Wonogiri dam catchment;

ii) A pilot implementation of a committee to coordinate watershed management in the Wonogiri dam catchment; and

iii) Strengthening local government; the forestry sub-Dinas and agriculture Dinas in Kabupaten Wonogiri; and

The rationale for their selection was simple. With the possible exception of i), they were judged to be the most likely to contribute to an earliest improvement to the condition of the watershed.

In addition, a further three recommendations, simpler to implement and not needing detailed prior discussion with government or stakeholders, were also chosen, namely:

v) Inclusion in mission statements of watershed management responsibilities;

vi) Transfer of more funds from central government to local government for capacity building purposes; and

vii) Implementation of Training Needs Analysis, especially for field staff.

In the following sections, each recommendation is expanded in more detail than in the Interim Report. Additional information provided by government and other stakeholders is included where relevant to assist implementation. Strengths and weaknesses of the three main recommendations are briefly assessed and next implementation steps proposed.

The following agencies and individuals were consulted in the review of these recommendations; Director of BPSDA, General Manager and staff PBS, Head of Programming BPDAS Solo, Secretary of Kabupaten Wonogiri and Heads of BAPPEDA, Forestry, and Agriculture in Kabupaten Wonogiri.

11.2 Funding Assistance from Wonogiri Dam Beneficiaries

11.2.1 Background

The relative poverty of farming communities upstream of large dams and weirs is well known and those living in the Wonogiri dam catchment are no exception. They have no access to large scale irrigation schemes and so are mainly dependent on rain fed crops, livestock and remittances from relatives working in big cities. Those farming downstream, by contrast, benefit from irrigation provided from a reservoir occupying some 8,800 ha of upstream land, and can grow up to three crops annually. This inequity has long been a source of dissatisfaction for the upstream communities and has been discussed many times in workshops and other forums. But to date, nothing has been implemented.

11.2.2 Possible Scheme

One obvious solution is to transfer some of the benefit from downstream communities[1] to those upstream, preferably in cash or near-cash (e.g. cheques from private bank accounts), for use in watershed management and also, crucially, for some extra cash for the farmers concerned. It is understood that informal investigations have revealed a willingness on the part of some downstream farmers to part with some of their extra income. Sums of Rp.25,000 per hectare per year have been suggested by several beneficiary farmers. However, a more comprehensive but tactful survey would be needed to establish a more realistic figure.

Assuming the 235 villages and 204,000 farmers in the Wonogiri dam catchment, and that each downstream farmer contributes Rp.25,000/ha/year, the maximum receipts per upstream village would be about Rp.3.2 million and per upstream farmer would be Rp.3,676. There is much to be decided here. Clearly, it would be simpler for the scheme to distribute money to villages and rely on village level agencies to distribute equitably to individual farmers. The money should be used as far as possible on soil conservation measures which are currently unfunded.

The scheme should distribute collected money to upstream villages and rely on village or sub village level agencies to distribute equitably to watershed conservation projects and, if appropriate, individual farmers, although this is less likely. The money should be used as far as possible on formally planned soil conservation measures which are currently unfunded.

11.2.3 Scheme Requirements and Possible Sequence of Actions

The basic requirements for such a scheme (in rough chronological sequence) would include the following. Possible agencies to be responsible overall are suggested.

(1) Preparation

i) After acceptance of the final report, the proposed scheme should be discussed in some depth with the decision-makers, especially Bupatis of the concerned kabupaten and the Governor of Central java Province, to obtain agreement in principle (Suggested overall responsibility: PBS)

ii) Surveys of downstream farmers (i.e. those benefiting from Wonogiri dam irrigation) and upstream farmers (i.e. those expected to receive benefit transferred from beneficiaries downstream, either in kind or, possibly, in cash). These would establish (or confirm) basic farmer data such as name, area of farm, willingness to participate in the transfer scheme without commitment at this early stage. Surveys could be carried out by WUAs or farmer groups and would provide formally established and agreed rosters of participating upstream and downstream farmers (Suggested overall responsibility: PBS as Implementing Agency plus WUAs / P3As).

iii) Extensive socialization of the proposed scheme to downstream and upstream farmers (Suggested overall responsibility by: PBS plus WUAs or farmer groups).

iv) MOUs or similar legal agreements between farmers and collecting/distributing agencies, and specifying, for downstream farmers, their payment obligations and any

[1] There are about 45,000 downstream farmers on about 30,000 ha of productive land taking water from the Wonogiri irrigation scheme. Upstream there are about 204,000 farmers [source: Village survey data of 2003] living in 235 villages with a total population of about 815,000 in the Wonogiri Dam catchment.

force majeure conditions for non-payment (Suggested overall responsibility by: PBS).

v) A detailed costed plan for installing and operating the scheme should be prepared. The plan should be agreed by those expected to fund start up and ongoing costs (Suggested overall responsibility by: PBS).

vi) Final approval of the scheme by Governor of Central Java and Bupatis of all concerned kabupaten[2]. This assumes that Kabupaten Ngawi in East Java province would not participate in the scheme. A formal agreement among the other downstream kabupaten to collaborate with the scheme should be established (Suggested overall responsibility by: PBS).

(2) Planning and Budgeting

i) A watershed management / conservation plan, probably annual but could be more frequent, giving a program for the conservation of the entire Wonogiri dam catchment for the year in question. The plan should be prepared within the framework of medium (say five years) and long term (say 20 years) strategic watershed conservation plans for the catchment. The annual plan should be costed as accurately as possible and should include conservation projects and costs from the agriculture sector (Suggested overall responsibility by: BPDAS Solo).

ii) Funding for the annual Wonogiri watershed conservation plan should be sought first from conventional sources, for example, local government and other local sources, provincial government, national government. The value of this financial support should be subtracted from the gross cost to give a net funding requirement for the scheme (Suggested overall responsibility by: BPDAS Solo).

iii) This net amount could then be divided between the downstream farmers (probably only in Central Java to avoid the complication of cross-province transactions for only one kabupaten (Ngawi) where delivery of irrigation water is least reliable) who have been identified by the comprehensive survey mentioned above. This division should be on some fair basis to be agreed with farmers; for example, according to farm area or farm income (more difficult to verify) (Suggested overall responsibility by: BPDAS Solo).

(3) Collection, Deposit and Distribution of Funds

(i) One agency[3] should ideally have overall responsibility for all transactions: collection (whether in cash or, preferably, via bank accounts); deposits to bank(s), and redistribution (whether in cash or, preferably, via bank accounts) to (a) specific watershed schemes or projects and (b) individual recipient farmers (possible but less likely). As BAPPEDA was rejected, another candidate in local government could be Kabupaten Dinas Finance, as money transactions are involved. Or a suitable NGO with relevant capability and experience: PERSEPSI is probably the best qualified for this demanding task, its workload permitting. Or, possibly, the Central Java province office of Agriculture (as farmers in several kabupaten are involved). Overall, the NGO option is probably the best, working in conjunction with Wonogiri Kabupaten

[2] Upstream: Wonogiri. Downstream: Sukoharjo, Klaten, Surakarta, Karanganyar, Sragen.
[3] Kabupaten Wonogiri BAPPEDA was suggested for this task but was rejected by a discussion meeting in Wonogiri on 26 September 2006. The reason given was that BAPPEDA is for planning & monitoring, not for managing a large financial project.

Dinas Finance (Summarizing, the suggested overall responsibility would be by: Central Java Finance; execution by Kabupaten Wonogiri Finance plus NGO).

(ii) The choice of bank or banks to handle the transactions is important. Ideally, the chosen bank(s) should have numerous branches, be trusted and experienced by farmers, and be competent and reliable. One bank appears to answer these criteria while being government owned: Bank Rakyat Indonesia (BRI - Indonesian Peoples' Bank). This bank is used by wealthier farmers, supplies credit to farmers, and is employed by GOI for distributing payment to farmers. However, the final choice should be made by Kabupaten Wonogiri Finance and approved by Central Java Dinas Finance after consultation with farmer representatives. Bank accounts should be opened for established farmer groups in sub villages rather than villages, to ensure responsibility is devolved to the lowest feasible level.

(iii) The actual collection, from farmer to bank according to pre-arranged calculations and agreements, could be handled by farmer groups based in each sub village. Another possibility would be to use a village level body, LPMD[4], although this tends to be less trusted by farmers than their own farmer groups. Distribution would be the task of representatives of authorized farmer groups or other bodies responsible for watershed conservation projects.

(iv) The bank should provide statements of transactions for inspection by the farmer groups involved. Suggested overall responsibility for iii) and iv) by: Central Java Dinas Finance; execution by relevant Kabupaten Dinas Finance.

11.2.4 Benefits and Risks

(1) Benefits

i) The scheme is an equitable way to balance dam benefits and costs between upper watershed farmers and dam beneficiary farmers in irrigated areas, assuming that scheme is implemented fairly (which cannot be guaranteed).

ii) Communication should improve between upstream and downstream areas; and

iii) There should be some reduction in government expenditure.

(2) Risks

i) Logistics are relatively complex which increases the possibility of transaction errors;

ii) The scheme will be costly to operate because of the large number of small farmers (and plots) in both upstream and downstream areas;

iii) Benefits to be transferred are unlikely to be more than Rp.3.2 million per upstream village and could be less in practice depending on the results of the survey. These are small amounts compared to the overall cost of watershed management and the complex logistics involved.

11.2.5 Next Steps

It is clear from the above text that this is an ambitious scheme. It would involve up to 250,000 farmers as well as government agencies in forestry, agriculture and finance in up to seven kabupaten in Central Java, and in Central Java Province itself, and one or more NGOs. Therefore implementation will require a significant amount of further design work,

[4] Lembaga Pembangunan Masyarakat Desa

costing and consultation.

It is therefore recommended that a further investigation should be undertaken by those with a thorough knowledge of upstream and downstream farmers and community organizations. The purpose would be to establish certain necessary aspects in more detail than could be achieved in this countermeasure for sedimentation study, including the following:

i) Consideration of whether a pilot scheme involving only a small percentage of upstream and downstream farmers is desirable and feasible, and if so which farmers should participate;

ii) Consideration of whether the whole exercise should be managed as a separate project under PBS;

iii) The logistics and methodology of the farmers' surveys and socialization of the scheme, confirmation of those who should organize and carry them out;

iv) The nature and content of the MOUs or legal agreements between the various parties in the scheme;

v) Planning start-up and operations, including banking arrangements;

vi) Estimation of scheme start-up and operating costs;

vii) The linkage between the beneficiary funding scheme and WC3 (discussed in the next Section 11.3), the proposed watershed management coordination committee;

viii) Consideration of whether contributing beneficiaries should include other downstream water users such as PLN, PDAMs, industrial concerns etc.

11.3 Coordination Mechanism for Watershed Management

11.3.1 Rationale

The institutional study identified the need for improved coordination of a) watershed management (WM) in upstream catchments like that of Wonogiri dam (to reduce sedimentation), and b) WM in the framework of WRM[5] in river basins generally. This problem is being addressed nationally by the GN-KPA movement. However, in the Wonogiri dam catchment it is essential to rapidly improve the quality of watershed management, especially in cultivated plots, to halt the inflow of sediment into the reservoir. For this, the Study recommends, among other things, a Wonogiri Watershed Conservation Coordination Committee (WC3), to be implemented as soon as possible.

11.3.2 Coordinating Project of GN-KPA in the Wonogiri Dam Catchment

A one-day regional meeting was held in Wonogiri, Central Jawa in December 2006. The meeting consisted of an explanation, promotion and discussion on GN-KPA as it might apply in Kabupaten Wonogiri. About 60 attendees included representatives from relevant national, provincial and kabupaten level agencies in addition to a NGO and the GN-KPA national inter-departmental work team. According to the meeting minutes, matters agreed during the meeting included:

i) Three components of GN-KPA (forest and land rehabilitation; water resources conservation; community empowerment) would be initially implemented in the

[5] Coordination of WRM should be carried out by PPTPA (basin level) and PTPA (province level), although not all are fully functional.

Keduang sub-watershed at 9 villages in five kecamatan, all in Kabupaten Wonogiri upstream of the Wonogiri dam. These were locations considered most in need of conservation activity.

ii) A GN-KPA team would be established in Kabupaten Wonogiri consisting of seven members from BAPPEDA (2 members including the team leader), forestry service, public works service, agriculture service, industrial trade service**,** and PERSEPSI (NGO in Wonogiri).

iii) A program of countermeasures will be arranged by the Ministries of Forestry and Agriculture and the DGWR. The Government of Central Java Province and Kabupaten Wonogiri will be coordinated by the secretariat of interdepartmental GN-KPA in parallel with the GN-KPA Team of Central Java Province.

iv) The Center for Research and Development of Socio Economy, Culture and Community Participation together with the GN-KPA Team of Kabupaten Wonogiri, will coordinate arrangement of materials and preparation of training for the candidate facilitators, supervisors, and motivators for empowerment as development stakeholders on GN-KPA implementation in the Bengawan Solo watershed, Keduang sub-watershed, Kabupaten Wonogiri, Central Java Province, for fiscal year 2007 and facilitated by PBS and PJT I Bengawan Solo.

v) BAPPEDA in Kabupaten Wonogiri will provide necessary logistical and administrative support.

vi) Preparation committee of GN-KPA Team on Kabupaten Wonogiri level will be followed by establishment of GN-KPA at Kabupaten Wonogiri level on December 2006 by a Bupati Decree.

vii) According to a letter from Minister of Public Works on implementation of GN-KPAs at Province, Kabupaten/Kota and sub-watershed levels, and a letter from Minister of Home Affairs about O&M of water resource structures, Provincial, Kabupaten/Kota governments should implement GN-KPA using APBD budget of Province, Kabupaten and Kota, and share the APBN for Department of Public Works, starting 2006 until 2009

viii) The GN-KPA program of work should be implemented by appropriate sectoral agencies coordinated by the secretariat of GN-KPA inter-departmental Team and the GN-KPA Team of Kabupaten Wonogiri, also facilitated by PBS and PJT I Bengawan Solo.

11.3.3 Membership, Responsibilities and Start-up of WC3

The purpose of WC3 would be to coordinate the planning, implementation, monitoring and evaluation of all watershed management (or conservation) in the Wonogiri dam watershed. This would be done using the responsible local government agencies and assisted by stakeholders representing the main interests in the area or who can provide technical advice and support. Only stakeholders with interests in the Wonogiri catchment would be allowed to vote on decisions. Technical or other advisers would have no vote. Initially, WRM activity would be excluded from WC3's remit in order to concentrate on watershed management and soil conservation.

It is not yet clear how and by whom the WC3 should be established as opinions vary. Some authorities say that the Ministry of Forestry should draft the legal product (as a Ministry Decree?) enabling WC3, under Law No. 41/1999. But presumably this would

not include agriculture which is much more important than forestry in terms of sectoral sediment creation. Others (including Director BPSDA in Jakarta) say that national legislation and approval is not necessary (although the Bengawan Solo river is strategic and crosses two provinces – East and Central Java) because the Wonogiri catchment is only a small part of the entire basin. A clear-cut ruling has not yet been obtained by the Study team.

WC3 would report administratively to Wonogiri Bupati and technically to BPDAS Solo. There should be some (unspecified for now) linkage to the local, presumed functional, PPTPA.

Members of WC3 should include a senior representative from:

- BAPPEDA, BPDAS Solo, Kabupaten Forestry Service, Kabupaten Agriculture Service, Kabupaten Environment Service, Perum Perhutani (from KPH Surakarta), PJT I Bengawan Solo, Balai PSDA,

together with one representative from each of the following stakeholder groups:

- Major landowners, farmer group representatives, community representatives, PLN, a competent local NGO, a University teaching and conducting research in watershed conservation (e.g. University of Gadja Mada). There may be other stakeholders who should be included.

Kabupaten Pacitan should provide some two members (amounting to about 10% of members, which is very roughly equivalent to Pacitan's proportion of Wonogiri catchment's surface area): one government and one non-government.

Non-government stakeholder representatives would be selected from volunteers by a working group of heads of the involved Kabupaten dinas and sub-Dinas, as well as the Kabupaten Secretary, according to agreed criteria.

The following are suggested for official positions:

- Bupati of Kabupaten Wonogiri as Chairperson,
- Head of Wonogiri Bappeda as Deputy Chairperson, and
- Head of BPDAS Solo as Secretary. BPDAS should provide a secretariat.

The lead role of BPDAS Solo in WC3 assumes that this agency has a detailed knowledge of the catchment and is willing and able to plan, monitor and evaluate all watershed conservation activity (or inactivity), especially that of the Agriculture Service, with the help of the relevant Kabupaten body.

In line with *otonomi daerah* and community empowerment, it is important that farmers and other members of the community participate fully, through their representatives, in the work of Wonogiri WC3.

A special budget for Wonogiri WC3 should be created, funded and administered by BPDAS Solo. WC3 members should meet at least once every 3 months and more frequently in the early stages.

The annual plan would be prepared by BPDAS in conjunction with forestry, agriculture, PJT1 Bengawan Solo and maybe other committee members. Monitoring and evaluation would be done by BPDAS with help from the appropriate Kabupaten agency. Plans, implementation, and results of M&E would be discussed with WC3 members so that everyone knows what is proposed and determined, and has a chance to comment and object.

These proposals have been largely agreed by BPDAS Solo, at the concept stage.

11.3.4 Potential Benefits and Risks from WC3

Potential benefits could include:

i) Improved condition of the watershed and therefore reduced sediment run-off into the dam reservoir;

ii) Better interaction between government units responsible for watershed management and stakeholders with various interests in the watershed;

iii) Ability of stakeholders, at least in theory, to influence watershed management in their interest.

Potential risks could include WC3 ineffectiveness due to: lack of leadership and support from top officials; lack of commitment and willingness to cooperate from members; lack of funds; and, most likely if not watched carefully, lack of WC3 attention to physical implementation of watershed conservation measures, especially in cultivated areas.

11.3.5 Next Steps

As soon as possible the appropriate agency at the appropriate level for drafting and progressing WC3 enabling legislation should be identified. When the final report is approved, and the WC3 recommendation is agreed, legal drafting should begin without delay. Hopefully by this time, the Presidential Decree and Ministry of Public Works Decree on coordination of water resources management at various levels of government, both now in draft, will have been issued. Linkages with GN-KPA coordinating activity in the catchment should be established (see subsection 11.3.2 above).

11.4 Strengthening Local Government

Local government agencies with specific responsibilities for watershed protection include (a) Environment, Forestry and Mining Services of Kabupaten Wonogiri (Dinas LHKP), and (b) Agricultural Services of Kabupaten Wonogiri (Dinas Pertanian).

It is recommended that Dinas Agriculture and Sub-Dinas Forestry in Kebpaten Wonogiri should be strengthened by increasing resources of funds, staff and equipment, and by putting more emphasis on field staff training.

11.4.1 Sub-Dinas Forestry

The Sub-Dinas Forestry is under the Dinas LHKP (Total staffing amounts to 126) as shown Figure 11.4.1 The Sub-Dinas Forestry has 80 staff in total and comprises four sections for:

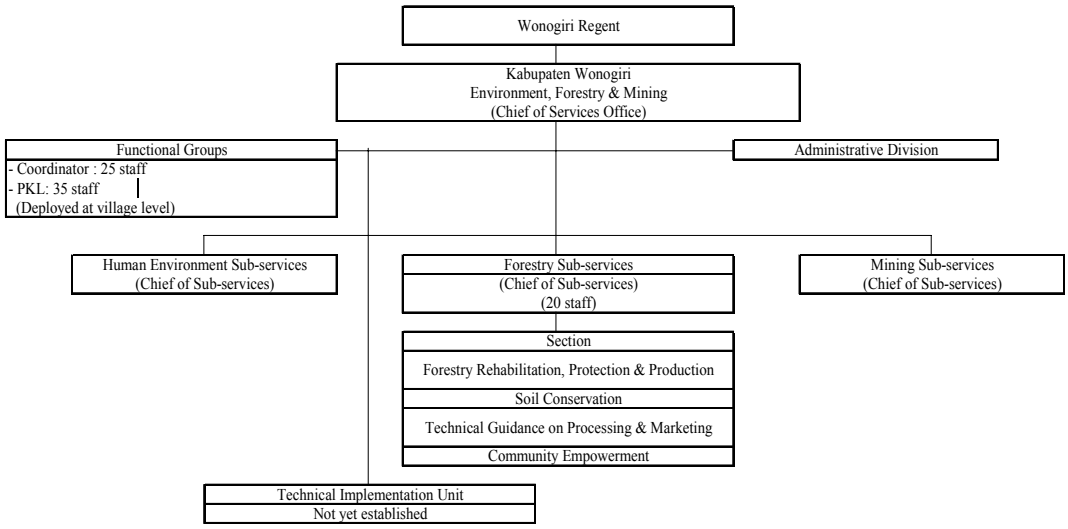
i) Forestry Rehabilitation, Protection and Production,

ii) Soil Conservation,

iii) Technical Guidance on Processing and Marketing of Forest Products,

iv) Community Empowerment.

There are 60 forestry trainers (forestry coordinators (1 per kecamatan)) and forestry extension workers (PKLs) who work with the 4 to 5 kecamatan staff undertaking extension duties in each kecamatan.



Source: Kabpaten Wonogiri

Figure 11.4.1 Organization Structure of Kabupaten Environment, Forestry & Mining Services Office, Wonogiri

(1) Organization

The Sub-Dinas Forestry should be upgraded to a full Dinas for the following reasons:

i) The vital importance of watershed management and soil conservation at the local level would be more fully recognized thereby thus facilitating its work. Out of a total kabupaten land area of 182,236 ha, some 51,000 ha (28%) is estimated to be either moderately critical or very critical, all requiring urgent action,

ii) Forestry is the largest sub-dinas in Dinas LHKP[6] and needs to grow considerably larger if it is to effectively impact the present erosion problems. This was confirmed at a recent meeting[7] of Kabupaten Wonogiri heads of Forestry, Agriculture and Planning, convened to provide more information for selected projects.

iii) A major increase in forest cover is needed to move from 11% towards the desired 30% of total area.

At the time of preparing this draft final report, it is understood that this recommendation had already been submitted to Bupati and the DPRD[8] together with other changes to Dinas LHKP requested by kabupaten management. These changes included (a) the transfer of Plantations from Agriculture to Forestry and (b) the creation of separate dinas for both Environment and Mining. The transfer of Plantations to Forestry is endorsed by the Study team.

(2) Staffing

i) Discussions with the Forestry Sub-dinas suggest that the number of field staff (coordinators and PKLs[9]) should be doubled from the present 60 to 120, to undertake the necessary work in the areas of forest development, production, industrial processes, and community development. Additional staff would be

[6] Dinas Lingkungan Hidup, Kehutanan dan Pertambangan – Environment, Forestry and Mining Services
[7] Held on 26 September 2006.
[8] Dewan Perwakilan Rakyat Daerah – District House of Representatives
[9] Penyuluh Kehutanan Lapangan – field forestry extension worker

concentrated in the catchments of the 4 rivers[10] receiving and delivering the most sediment. Each PKL should be allocated to a fixed area for which he or she is solely responsible. Office staff could be reduced from the present 20 to 15.

ii) Forestry management says that field staff capability is adequate but more training is needed so that field personnel can work more effectively with less supervision. However, other sources have criticized the effectiveness of forestry field staff. Either way, it seems that more training and probably more supervision in the field is needed. Formal training courses are provided from Cirebon Forestry Training Center in West Java. These should be supplemented by on-the-job training from the Sub-dinas head.

iii) The training needed for existing field staff should be determined as soon as possible by Training Needs Analysis (TNA) (see subsection 11.6.3 below) and implemented before any additional staff is acquired.

(3) Equipment

More office equipment is needed especially for mapping and surveying. Both activities can be outsourced but, it is estimated, can be done more cheaply in-house while adding to staff expertise and work variety, thus improving morale.

(4) Budgets and funding

The 2005 budget for capital and operating expenditure (excluding salaries) was reduced from a requested Rp.852 million to an actual Rp. 368 million, a shortfall of 484 million and a reduction of 57%. Four[11] of the 9 expenditure categories received no funds, two[12] received reduced funds, and only three (village seedling garden, erosion and sedimentation countermeasures, and improvement of primary wood industry) received the funds requested. Forestry budgets should be fully funded, wherever possible.

(5) Potential benefits and risks

Potential benefits could include:

i) The higher profile and better funded Dinas Forestry, comprising better trained existing and additional field staff, and more productive office personnel, should be able to overcome progressively the outstanding problems of the watershed; for example the reclamation of some of the critical land in the Wonogiri catchment.

Potential risks could include:

(i) The improved and enlarged field staff and reduced office staff may not be employed productively due to weaknesses in Dinas Forestry management. Both head of Dinas and Bupati should objectively and routinely assess the quality of management and adopt the measures needed to improve this.

(6) Next Steps

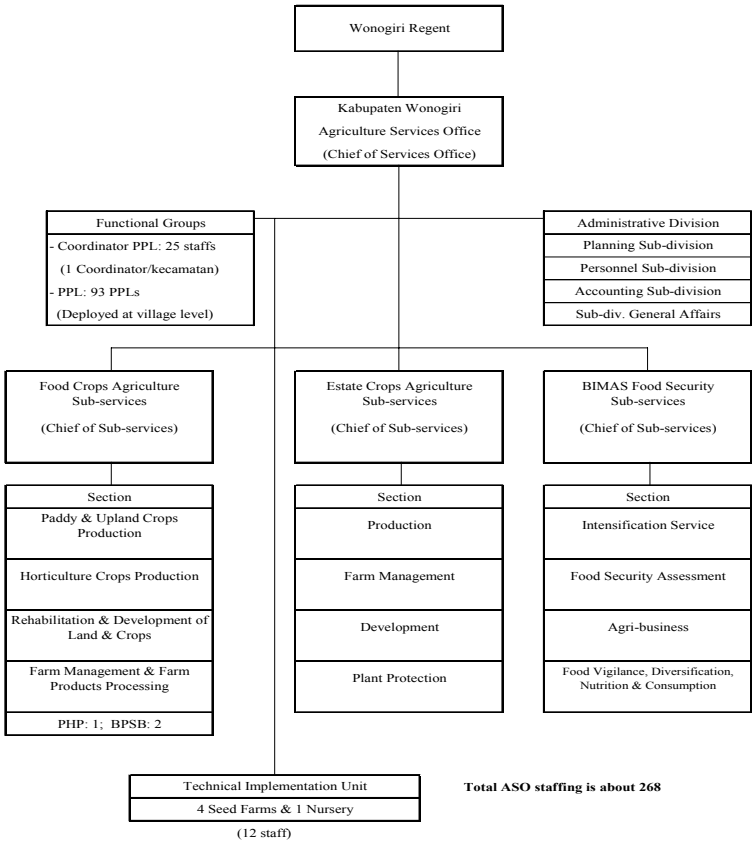
Along with the anticipated upgrade of the Forestry Sub-Dinas, the assessment of the training needs of the existing field staff (coordinators and PKLs) should be started soonest. This should be done by the Sub-Dinas (or Dinas) head, advised by a human resources specialist, preferably from provincial government, with experience in TNA. The

[10] Keduang (in particular), Tirtomoyo, Temon, Upper Solo (Solo Hulu)
[11] People's forest development, castor oil development, economic and other assistance to forest community.
[12] Training for forest community, trade development assistance for forest community.

necessary training should then be provided, after which the total staff needs should be carefully re-assessed and approved, and action taken to obtain the additional field staff required.

11.4.2 Dinas Agriculture

The organization structure of Dinas Agriculture is shown in Figure 11.4.2 below.



Source: Kabpaten Wonogiri

Figure 11.4.2 Organization Structure of Kabupaten Agriculture Services Office, Wonogiri

In the organization structure, there are 3 Sub-Dinas:

i) Food Crops Agriculture

ii) Estate Crops Agriculture

iii) BIMAS Food Security.

The total staffing is currently about 268, 118 of these being field extension coordinators and extension workers based in the 25 kecamatan offices, and 12 in the UPTD (Unit Pelaksana Tehnis Dinas) for seed and seedling cultivation.

(1) Vision and Mission Statement

The Vision (and Mission Statement) for the Agriculture Service must include a specific reference to soil conservation and sustainable land management, not the case at present. This important addition should be accompanied by a much greater emphasis on watershed conservation in all agricultural activities. At present, it seems that there is virtually no legislation dealing with watershed conservation in agricultural work, which must be linked to the criticism of PPLs reported in paragraph (2) below.

(2) Staffing

As for forestry, field staff are estimated to be fewer than needed due to budget limitations. There are currently 118 staff to service 294 villages, the total number in Kabupaten Wonogiri. Ideally, there should be one extension worker per village. Failing this, a minimum of 40 additional PPLs[13] is considered necessary for adequate cover. However, existing PPLs have been strongly criticized[14] for the lack of effort put into watershed conservation. Production is said to be the exclusive objective. This suggests that there is much to be done to improve watershed management in the agricultural sector.

(3) Training

Agriculture managers estimate that most staff would benefit from general refresher training. As part of this or in addition to it, a program of training for existing field staff (and probably higher levels also) on watershed conservation best practice is urgently needed. Such training should be given to existing PPLs before recruiting more.

(4) Equipment

There is a shortage of functional computers (10 more are needed, some to replace old models). Also needed are a rainfall gauge and ubinan equipment for agricultural production.

(5) Budgets and funding

Past Agriculture Services budgets have usually been under funded. For example, in 2005, data shows that only 41% of the planned expenditure could be funded. Public Services suffered a particularly savage reduction of 73%. Thus, to fully fund the planned expenditure in 2005, a further Rp.15 billion would have been needed for this Dinas. It is imperative that the budget, at least for watershed conservation activities, is fully funded in future.

(6) Potential benefits and risks

Potential benefits could include:

i) More references to policy and practice concerning soil conservation in legal products and manuals at all levels of government.

ii) Better soil conservation practice by farmers due to more effective farmer training and extension by more and better trained Agriculture Services field staff, and therefore less sediment flowing into the reservoir.

Potential risks could include:

i) The improved and enlarged field staff may not be employed productively due to weaknesses in Dinas Agriculture management. Both head of Dinas and Bupati should objectively and routinely assess the quality of management and supervision, and should adopt the measures needed to improve this.

(7) Next Steps

The important first step is to carry out an assessment of training needs among the existing field staff (PPLs and coordinators) as for Sub-dinas Forestry. This should be done by the dinas head, advised by a human resources specialist, preferably from provincial

[13] Penyuluh Pertanian Lapangan – field agriculture extension worker.
[14] By BPDAS Solo, among others.

government, with experience in TNA. The necessary training should then be provided, after which the total staff needs should be carefully re-assessed and approved, and action taken to obtain the additional field staff required.

11.5 Law Enforcement

The recommendation for tackling the lack of law enforcement in the Wonogiri watershed was not selected for the Feasibility Study. Instead, it is strongly recommended, without the formal establishment of a task force, that all managers and staff in Kabupaten Wonogiri from the Bupati down to the cleaner, both observe the law and enforce it. This is especially necessary in State forests, where it seems that illegal activities continue without hindrance.

11.6 Other Recommendations

11.6.1 Vision and Mission Statements

To raise the profile of watershed management, Vision and Mission Statements of all forestry (including the State Forestry Company) and agriculture agencies at all levels should state clearly the responsibility of the agency concerned for watershed management and soil conservation.

11.6.2 Transfer of Resources from Central Government to Local Government

Sufficient funds should be transferred from Central Government to allow adequate capacity building in the Sub-dinas Forestry and Dinas Agriculture, Kabupaten Wonogiri.

In addition, Kabupaten Wonogiri and Central Java Province should make serious and systematic efforts to raise money from cost reduction (e.g. labor costs too high) and business development.

11.6.3 Staff Training

All managers–especially in Kabupaten Forestry and Agriculture–should formally review the competence and level of training of each member of their staff against what is needed for that job and preferably specified in a job description (this is Training Needs Analysis).

From this exercise, the training (or other action) needed should be determined individually by the manager concerned (with help from HR specialists if necessary), reviewed with others in the group, prioritized and later programmed according to greatest benefit for the individual and the group. Training should then be given as programmed.

CHAPTER 12 TECHNOLOGY TRANSFER

12.1 Technology Transfer

"Technology Transfer" is one of the main objectives of this Study. Technology transfer has been conducted by means of on-the-job training, joint meetings and workshop/seminar during the course of the Study. The result of technology transfer is outlined as follows:

12.2 On-the-Job Training

Considering an efficient technology transfer to counterpart personnel through on-the-job training, man-to-man basis assignment of the counterpart personnel is preferred. Further all of the counterparts are expected preferably to work full-time with experts during the Study. An active involvement of the counterpart personnel would be of great importance.

Through the Study period, 26 counterparts during the first field works and 22 counterparts during the second and third field works were assigned from the agencies concerned. Although some counterparts were unavoidably on a part-time basis, all the counterparts were cooperative. Each expert of the Study Team discussed and worked very closely with the respective counterpart. Such joint work includes field reconnaissance, field survey and investigation, data collection, preliminary analysis, field observation and measurement, etc. in the respective field of the experts.

12.3 On-the-Job Training on GIS

GIS is one of powerful and useful tools to manipulate the supporting data for master plan formulation on sedimentation problem in the reservoir. Therefore JICA Study Team has developed Wonogiri GIS database and utilized for estimation of the volume of sedimentation in the reservoir as well as sediment production in the watershed.

On the other hand, the knowledge and skills on GIS was not sufficient in counterpart organization since GIS technology had been rapidly utilized in many fields in Indonesia. Based on the above actual condition, JICA Study Team conducted technology transfer on GIS as follows:

12.3.1 GIS Training Seminar

JICA Study Team conducted GIS training seminar twice in 2005 and 2006. The summary of the seminars are shown in the following table.

Table 12.3.1 Summary of GIS Training

	First GIS Training Seminar (Nov.28 - Dec.2, 2005)	Second GIS Training Seminar (Dec.11 - Dec.14, 2006)
Contents	- What is GIS - How to use ArcMap - Calculation of sedimentation volume in the Wonogiri reservoir - Notification of the importance of appropriate monitoring of echo-sounding	- How to use ArcMap - Calculation of sediment yield in the Wonogiri watershed - Presentation on the GIS training output - Discussion on updating and management of Wonogiri GIS database
Participants	9 persons in total - PBS: 6 persons - PJT-1: 3 persons	7 persons in total - PBS: 5 persons - PJT-1: 2 persons
Place	Computer room in Seberas Maret University (UNS)	
Photo	 	 

12.3.2 Pre / Post Evaluation of GIS Training

Questionnaires were distributed to the training participants in both training seminars for pre and post evaluation of their understanding on GIS. The results are as follows:

(1) Pre training questionnaire

In first training, it was clarified that only two persons out of nine participants had knowledge on GIS and all persons had no experience of utilization of GIS software before the training. In addition, most of all participants felt the necessity of GIS utilization in their daily work seriously.

On the other hand, most of all participants had the knowledge on GIS because i) three trainees were assigned to participate continuously from the previous training and ii) the younger generation, who had been interested in GIS and taken attention of our GIS activities, took part in the training. In addition, it was thought that they understood the potential and limitation of GIS judged from the Q3 in the following table.

Table 12.3.2 Result of Questionnaire

Pre training questionnaire
Q1. How much do you know about GIS?
Nothing: 7, Little: 2, Much or Very much: 0
Nothing: 2. Little: 5, Much or Very much: 0
Q2. Have you ever used GIS software?
Yes: 0, No: 9
Yes: 5, No: 2
Q3. Do you think GIS can provide you with useful information for your future work?
Very useful: 5, Useful in some case: 4, Not so useful or Not at all: 0
Very useful: 1, Useful in some case: 5, Not so useful: 1, Not at all: 0
Post training questionnaire
Q1. Do you think this seminar is useful for your future work?
Yes: 9, No: 0
Yes: 6, No: 1
Q2. Was this seminar able to enhance your knowledge on GIS?
Yes: 9, No: 0
Yes: 7, No: 0
Q3. Do you think GIS can provide useful information for planning of sedimentation problem?
Very useful: 9, Useful in some case: 0, Not so useful or Not at all: 0
Very useful: 6, Useful in some case: 1, Not so useful or Not at all: 0
Q4. What did you think of this seminar?
Overall: Good: 8, Fair: 1, Poor: 0
Lecture: Good: 6, Fair: 3, Poor: 0
Material: Good: 3, Fair: 5, Poor: 1
Your understanding: Good: 0, Fair: 3, Poor: 6
Overall: Good: 3, Fair: 4, Poor: 0
Lecture: Good: 5, Fair: 2, Poor: 0
Material: Good: 5, Fair: 2, Poor: 0
Your understanding: Good: 4, Fair: 1, Poor: 0 (No answer: 2)
Q5. What kind of seminar about GIS would you like in the future? (1st Training) - Same kind of practice with completed GIS manual, - More training for GIS beginner, - More advanced training for watershed management and water balance study, etc.
What kind of work do you want to apply GIS in the future? (2nd Training) - All works related to mapping or sedimentation, - Water resources management and water resources allocation along Bengawan Solo river, - Flood control of Bengawan Solo river, etc.

Upper: First GIS training, Lower Second GIS training
Source: JICA Study Team

(2) Post training questionnaire

The knowledge and skills on GIS became deeper through the GIS training. And also, they were satisfied with the overall training programs and the contents in the first training. However, they reported the requirement of i) extension of the training period, ii) application of different field, especially watershed conservation and water resource management, and, iii) completed GIS manual.

On the other hand, the second training could not provide full satisfaction but a part of GIS knowledge and skills on which the participants wanted to know. The reason was assumed from the answers from the post training questionnaire. Their greatest concerns on utilizing GIS were mainly categorized as two issues, i.e. i) optimal water resources allocation and ii) flood control of whole Bengawan Solo river not only in Wonogiri reservoir and the watershed. Therefore, it was emphasized in the discussion that the trained skills were not enough for applying to the above issues and the further effort was highly required through self-learning to apply the above issues.

12.3.3 Operation, Management and Updating of Wonogiri GIS Database

After handing over the Wonogiri GIS database to the counterpart organizations, continuous monitoring of condition in the reservoir and watershed are strongly recommended using the database. To keep the uniformity of data accuracy, new institutional arrangement is inevitable, that is to say, data management center needs to be established. And then, all the latest data should be managed, updated and distributed to the organizations concerned.

The following table shows the final decision on the data management through the discussion in counterpart meeting.

Table 12.3.3 Institutional Arrangement for Management of Wonogiri GIS Database

Responsible Organization on the Data Management	PBS before establishment of new data center (New data center will established under President Decree No.7, 2004)	
Frequency of Updating	Once in 5 years	
Data to be Updated and the responsible organization of data collection	Data Name	Organization to Collect Data
	High priority	
	Sedimentation in Reservoir and related data	PBS (whole reservoir) PJT-1 (in front of intake)
	Land Use	BAPPEDA Wonogiri
	Terrace condition	Kabupaten Wonogiri (Agriculture/Forestry office)
	Satellite Image	BP2TPDAS
	Mid priority	
	Administrative boundary	BAPPEDA Wonogiri
	River	PBS
	R factor (Rainfall)	PBS
	K factor (Soil)	BPDAS, Kabupaten Wonogiri (Agriculture/Forestry office)
	Structure information (Check dam, River bank protection, etc.)	PBS, Kabupaten Wonogiri (Agriculture/Forestry office)
	Off-farm erosion	PBS, Kabupaten Wonogiri (Agriculture/Forestry/PU office)

Source: JICA Study Team

12.4 Joint Meeting with Counterpart Personnel

A joint meeting with counterpart personnel was started in November 2004 in the first field works in Indonesia. The meeting was expected to be held once per month. Totally 19 times the meetings were held during the field works period. Other staffs of PBS and sub-contractors that were entrusted with field investigations under the Study also participated in the joint meetings. The purpose of joint meeting is:

i) Confirmation of work progress of the Study,
ii) Report and confirmation of progress of the entrusted field investigation and survey works,
iii) Report and technical discussion on the ongoing field investigations undertake by the Study Team in collaboration with counterparts,
iv) Presentation of technical topics by the expert of the Study Team that are proposed from the counterpart, and
v) Question and answer on the specific/general topics raised during the joint works, and

vi) Discussion on outstanding issues and pending matters.

Along this line, joint meeting has been continued until the end of third field works. Main points of the joint meetings on technical works are outlined below:

Table 12.4.1 Contents of Counterpart Meetings

No.	Date	Participant *	Agenda
1	Nov 1, 2004	30 persons	i) Opening remarks by Ir. Tri Rohadi (Chief counterpart, manager for planning of PBS). Self-introduction of all the participants. Discuss on the objectives and operation of joint meeting. ii) Report the progress of the ongoing field investigations by sub-contractors. Then discuss on issues of field investigations, especially how to supervise and coordinate efficiently. iii) Request for data collection of the existing small irrigation dams and check dams in the Wonogiri catchment. vi) Report the interim findings on the current watershed management and erosion control. v) Explain the JICA's new policy on environmental and social considerations for projects, data collection for clarification of existing environment, findings, planned field investigation on water quality and bed materials.
2	Dec 2, 2004	43 persons	i) Report the progress of the ongoing field investigations by sub-contractors. ii) Explanation of the methodology of the ongoing hydrologic investigation from the request of the counterparts. iii) Explain the progress and the methodology of the ongoing field erosion tests from the request of the counterparts. vi) Report the interim findings on the current watershed management and erosion control. v) Lecture of "Sediment Removal System" by the expert, which was requested to explain in detail at the first joint meeting.
3	Dec 16, 2004	48 persons	i) Introduction of newly arrived experts from Japan. ii) Report the progress of the ongoing field investigations by sub-contractors. iii) Explanation of the schedule of Study Team and assignment of one expert in February 2005 for the hydrologic investigation. vi) Discuss field measurement of rainfall and soil erosion at the soil erosion test sites. v) Establishment of task force team within PBS for the workshop to be held on December 28, 2004. vi) Lecture of "Geographic Information System (GIS)" by the GIS expert, which was requested to explain in detail at the second joint meeting. He explained; definition of GIS, composition of GIS, outcomes of GIS, GIS analysis, data base, list of data collected, GIS data for watershed conservation, etc.
4	Jan 11, 2005	45 persons	i) Report the progress of the ongoing field investigations by sub-contractors. ii) Explanation and discussion the draft results of reservoir sedimentation survey (revealed current status of sedimentation in the Wonogiri reservoir). iii) Explanation and discussion of the ongoing land use survey. vi) Explanation of the schedule of Study Team in the next field works around from May. v) Explanation and review of the minutes of meeting of workshop held on December 28, 2004.
5	Feb 13, 2005	25 persons	i) Explanation of the result of Sedimentation Analysis. ii) Explanation of the result of Flume Erosion Test.
6	May 25, 2005	22 persons	i) Explanation on the overall schedule of the second field works of the Study. ii) Explanation of the results of the Wonogiri reservoir sedimentation survey

No.	Date	Participant *	Agenda
			conducted in 2004. iii) Discussion on assessment of past reservoir survey results and method, and on setting-up of monitoring system for additional reservoir survey in 2005. iv) Explanation of the village assessment and action plan survey in the Wonogiri watershed, which soon commences under the Study entrusting the NGO in Wonogiri. v) Discussion on how to conduct the village action plan survey effectively, and on monitoring method of the survey progress.
7	Jun 14, 2005	24 persons	i) Explanation of the results of hydrologic investigation conducted during the wet season from November 2004 to May 2005. ii) Discussion on the hydrological analysis to be made in the succeeding study using the results of hydrological investigation. iii) Explanation of the contents of JICA guideline on environmental and social considerations, and the scope of works of Initial Environmental Examination (IEE) to be entrusted to sub-contractor under the Study. iv) Discussion on the contents and method of IEE.
8	Jul 20, 2005	37 persons	i) Introduction of newly mobilized experts; the institutional/laws and regulations expert and sediment hydraulic expert. ii) Explanation of the progress of identification survey of geological condition of the Wonogiri watershed; specially gully erosion. iii) Discussion on the estimation method of gully erosion and assessment of effectiveness of the past gully plugging structures. iv) Explanation of the progress of identification survey of erosion condition of the Wonogiri watershed. v) Discussion on the current bench terrace management conditions, conservation method, and suitable crops/trees on the terrace. vi) Schedule of the second workshop. vii) Progress of the tender of the verification test for reservoir sediment removal system.
9	Aug 26, 2005	–	Preparation of the 2nd Workshop
10	Aug 30, 2005	–	Preparation of the 2nd Workshop
11	Sep 6, 2005	–	Preparation of the 2nd Workshop
12	Oct 3, 2005	20 persons	i) Briefing on verification test for sediment removal system in the Wonogiri Multipurpose Dam reservoir. ii) Discussion on the request of some arrangements from the contractor during the verification test. iii) Explanation of the verification test in the field. iv) Discussion on how to conduct the verification test effectively and successfully during the limited period.
13	Oct 26, 2005	26 persons	i) Briefing on the result of verification test for sediment removal system in the Wonogiri Multipurpose Dam reservoir. ii) Discussion on the result of verification test and the garbage problems related to the implementation of the test. iii) Explanation of the sub-contractor work progress of Initial Environmental Examination (IEE). iv) Discussion on the contents and method of IEE. v) Explanation of the sub-contractor work progress of survey on village assessment and village action plan. vi) Discussion on the contents and method of survey on village assessment and village action plan. vii) Explanation of the result of the Study Team works of water quality

No.	Date	Participant *	Agenda
			assessment. viii) Discussion on how to make an interpretation of the result of the laboratory test conducted in this Study.
14	Dec 15, 2005	21 persons	i) Explanation of the result of the village workshop held in Wonogiri, which is a part of sub-contractor works of survey on village assessment and village action plan. ii) Discussion on the issues newly recognized through the village workshop. iii) Briefing of the result of the first GIS seminar. iv) Explanation of impact caused by sediment flowing from the Wonogiri Dam reservoir to the Colo Weir and its irrigation system. v) Discussion on the above issues.
15	Jan 20, 2006	20 person	i) Explanation from the Manager for Planning of PBS in relation to the establishment of GNKPA (Gerakan Nasional Kemitraan Penyelamatan Air: National Movement on Partnership for Water Preservation). ii) Explanation from JICA Study Team on the necessity of data collection for the coordination of critical lands. iii) Discussion on following up the Presidential decree on the establishment of GNKPA.
16	Feb 2, 2006	–	Preparation of the 3rd Workshop
17	Jul 12, 2006	21 persons	i) Explanation of comparative process on structural measures against reservoir sedimentation in the Wonogiri reservoir. ii) Answer to the questionnaire for Interim Report submitted and explained in Steering Committee at Jakarta. iii) Explanation of watershed management proposed in Master Plan.
18	Jul 27, 2006	21 persons	i) Explanation of two dimensional analysis on sedimentation in the Wonogiri reservoir. ii) Explanation of un-affectivity of check dam and other structural countermeasures against sedimentation in the Wonogiri reservoir.
19	Jan 8, 2007	–	Preparation of the 4th Workshop

* including all of the experts of Study Team and counterparts, and some PBS staff
Source: JICA Study Team

Jan 11, 2005

May 25, 2005

June 14, 2005

July 20, 2005

October 3, 2005

December 15, 2005

Photo: Snap of the joint meeting with counterparts

12.5 Workshop/Technical Transfer Seminar

Public consultation has been common for incorporating the various demands and needs of communities and stakeholders into the process of planning. The consultation process is therefore of great importance, aiming at empowering the stakeholders in project identification and implementation.

During the Study period, the Workshops have been held four times as follows:

Table 12.5.1 Contents of Workshops

The 1st Workshop	Date : December 28, 2004
	Place : Novotel Solo, Surakarta city
	Participant : 124 persons
	Objective : i) To introduce the schedule and outline of the JICA Study to all the stakeholders concerned, ii) To present the progress and preliminary results of the study made during August - December 2004, iii) To share the lesson learned through past experience on countermeasures for sedimentation in Japan, and iv) To exchange opinions and receive comments form stakeholders concerned to reflect further study content and master plan.
The 2nd Workshop	Date : September 8, 2005
	Place : Novotel Solo, Surakarta city
	Participant : More than 100 persons
	Objective : i) To explain the progress to date of the JICA Study during the second field works from May to August, ii) To share the current condition and issues on the Wonogiri Multipurpose Dam sedimentation and Wonogiri watershed condition, iii) To share the lesson learned through past experience on watershed management projects, mainly by the World Bank in 1989-1994, and iv) To exchange opinions and receive comments form stakeholders concerned to reflect master planning of integrated countermeasures for the Wonogiri Multipurpose Dam sedimentation problems.
The 3rd Workshop	Date : February 14, 2006
	Place : Hotel Quality Solo, Surakarta city
	Participant : More than 100 persons
	Objective : i) To explain the progress to date of the JICA Study during the second field works from October 2005 to January 2006, ii) To explain and discuss the basic strategies for master planning on Wonogiri reservoir sediment management system, iii) To explain and discuss the basic strategies for master planning on Wonogiri watershed conservation and management, and iv) To exchange opinions and receive comments form stakeholders concerned to reflect master planning of integrated countermeasures for the Wonogiri reservoir sedimentation problems.
The 4th Workshop	Date : January 18, 2007
	Place : Novotel Solo, Surakarta city
	Participant : More than 100 persons
	Objective : i) To explain the Master Plan of countermeasures for sedimentation in the Wonogiri multipurpose dam reservoir, ii) To deepen the understanding on the M/P through discussion, iii) To introduce hydrological modeling in Japan for sediment control and water resource management, iv) To discuss suitable organization setup for implementation of non-structural measures in the watershed, and v) To exchange opinions and comments from stakeholders for realization of M/P

Source: JICA Study Team

The Minutes of Meetings on the respective workshops are shown in the Supporting Report III Annex No.17.

CHAPTER 13 CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

It may be concluded from both the Master Plan Study and Feasibility Study that:

i) The Wonogiri multipurpose dam completed in 1981 is the sole large reservoir on the Bengawan Solo River. The Wonogiri dam has contributed much to social welfare in the basin and has greatly benefited the country in terms of both regional and national economic developments.

ii) The Wonogiri reservoir has been suffering from sediment deposits and garbage at the intake that provides water for power generation and irrigation water supply. The Keduang River that enters the reservoir just upstream of the dam is the primary cause of the current sediment-related problems. The sediment and garbage from the Keduang River have deposited massive quantities of sediment in the forebay adjacent to the dam. The reservoir sedimentation survey in 2006 showed sediment deposition depth of approximately 20 m in maximum in the forebay. It was predicted that in the near future the forebay area would be completely filled with sediment deposits due to continuing sediment inflow from the Keduang River. Establishment of sustainable sediment management system in the reservoir has become crucial.

iii) The main source of the sediment was identified as the soil erosion from the cultivated upland fields and settlement areas within the Wonogiri dam watershed. The volume of annual soil erosion is estimated at around 93% of the annual sediment inflow into the reservoir (annual average 3.2 million m^3 in 1993-2004). Such high soil erosion rate might be caused as a consequence of the poor land management and agricultural development that local farmers had to adopt, due to poverty and the large farming population, in the topographically critical areas on steeper mountain slopes. Out of sub-watersheds, the Keduang watershed produces the highest soil loss.

iv) Urgent countermeasures (the Project) were proposed in the Master Plan. The Project aims at securing the proper function of the intake with provision of combination of structural and non-structural measures to cope with the sediment inflow into the reservoir from the Keduang River. The watershed conservation in the Keduang sub-watershed as the non-structural measure will mitigate sediment yield, thereby reducing the sediment inflow from its watershed. The sediment storage reservoir as the structural measure will release the sediment inflow from the Keduang River to the downstream reach through the new spillway; thereby the sedimentation at the intake will be drastically decreased.

v) Most of the sediment and garbage inflow from the Keduang River will be completely retained in the sediment storage reservoir. The existing intake will become completely relieved from the current sediment-related issues. The retained sediment and garbage in the sediment storage reservoir will be easily released from the new spillway.

vi) Implementation of the watershed conservation will be carried out by means of community-based management, encouraging the local farmers to increase farm income and thereby to improve the quality of life by improving their current land

use practices. This comprehensive approach for the watershed conservation will much contribute to poverty alleviation providing stabilization of the farmers' economic situation.

vii) The Project is technically sound and economically feasible, showing high economic viability with an EIRR 16.4%. The Project will make sustainable operation of the Wonogiri reservoir possible and contribute to stabilization of the livelihood of people in the local communities as well as improvement of social welfare from the national economic points of view.

13.2 Recommendations

Recommendations from both the Master Plan Study and Feasibility Study are summarized below:

i) The Wonogiri dam is one of the lifelines of the national infrastructures. The economic value of the Wonogiri dam for water storage is undoubtedly very high. As stipulated in the Scope of Works, it was agreed between DGWR and JICA that the goals of the Study is to implement the proposed countermeasures to secure the long-term ability of the Wonogiri reservoir. Because of the urgent needs to cope with the sediment inflow, the Project should be implemented as early as possible to keep the intake functioning properly.

ii) In the highly populated Java Island, the reservoir is a precious water source that would be very difficult to replace when once it is completely filled with sediments. From a realistic view points, it would be difficult to develop a new reservoir. It is strongly recommended that technical approaches and solutions provided under the Study should be applied to solve similar sedimentation problems in the existing reservoirs in Indonesia.

13.3 Steering Committee Meeting on May 30, 2007

The Steering Committee Meeting was held in Jakarta on May 30, 2007 to discuss the content of the Draft Final Report as well as the comment at the JICA Advisory Committee Meeting held at the JICA headquarters in Tokyo on May 24, 2007.

The Advisory Committee organized by JICA provides technical guidance and advices to the JICA Study at milestone stages of the Study. The Advisory Committee advised to confirm the intension of the Government of Indonesia to implement the watershed conservation project for the Keduang River basin as the urgent plan. This was due to the consideration that as the reduced portion of the sediment inflow from the Keduang River basin by the watershed conservation works could be released to the downstream reach through the new spillway in the sediment storage reservoir, watershed conservation works for another river basin might be given the higher priority in view of effectiveness of investment.

As a result of discussion at the Steering Committee Meeting, the Government of Indonesia decided to implement the watershed conservation project for the Keduang River basin as the urgent plan based on the following reasons:

i) For the implementation of the watershed conservation project as proposed by JICA Study, coordination and integration with the ongoing community-based programs in the Wonogiri dam catchment, mainly Keduang River basin, under GNKPA (i.e. coordination programs among Ministry of Public Works, Ministry of Forestry and Ministry of Agriculture in accordance with the MOU) would be very important.

ii) Flood control is the main function of the Wonogiri reservoir. In view of mitigation of flood and sediment inflow, watershed conservation and management for the Keduang River basin would be ranked as top priority.

iii) The sediment storage reservoir would become check dam or sand pocket in future without proper operation. If the sediment storage reservoir is filled with sediment deposits, almost all of the sediment inflow from the Keduang River would overflow into the main Wonogiri reservoir. To avoid this critical situation, proper operation of sediment storage reservoir and watershed conservation in the Keduang River basin would be very important.

Part II Feasibility Study

Tables

Table 6.5.1(1) Summary of Environmental Management and Monitoring Plans for Negative Impact on Physical and Biological Components

Environmental Components	Impact	Impact factor / activity	Environmental Management	Environmental Monitoring
(1) Physical Components	1) Drawdown of groundwater	Excavation work for spillway	• Socialization of schedule of excavation work as well as possible impact and compensation (alternative water supply) to local people before excavation work.	• Continuous measurement of groundwater level in domestic well in the nearest village (Dusun Petir) before, during and after the excavation work for spillway
	2) Deterioration of air quality (dust), noise and vibration	Construction works to be conducted near settlement area	• Socialization of schedule of construction works as well as possible impact and compensation to local people, • Watering and sheet covering on excavated materials , • Establishment of noise mitigation wall at the boundary of construction site, • Considering arrangement of construction machines as well as establishment of trench in between construction site and settlement area to mitigate intensity of vibration.	• Measurement of air quality (NO2, SO2, CO, Dust (TSP), CH and other parameters) as well as noise and vibration levels during excavation works at the nearest settlement area.
	3) Deterioration of water quality of Bengawan Solo River	Sediment releasing from sediment storage reservoir	• Arrangement of timing and duration of sediment releasing corresponding to the environmental monitoring result on water quality in downstream stretch of Bengawan Solo River.	• Measurement of water quality (SS, Turbidity, DO, BOD, COD, pH and other parameters) as well as impacts on fish (death and injury) both during sediment releasing non-releasing period, • The measurement is to be conducted at downstream of Wonogiri dam, Colo weir, Jurug bridge and Tangen bridge simultaneously.
(2) Biological Component	1) Decrease of individuals of terrestrial flora and fauna species	Site clearance (cutting of vegetation)	• Minimizing site clearance required for project facilities, • Release of fauna species when some individuals were caught during civil works	• The area of site clearance due to the implementation of project, • Inventory of terrestrial flora and fauna species after project facilities are constructed.
	2) Impacts on fish in the Bengawan Solo River	Increase of SS concentration due to sediment releasing from sediment storage reservoir	• Arrangement of timing and duration of sediment releasing corresponding to the environmental monitoring result on water quality and impacts on fish species in downstream stretch of Bengawan Solo River.	• Inventory of fish species as well as plankton and macro-benthos in the downstream of Bengawan Solo River periodically.

Table 6.5.1(2) Summary of Environmental Management and Monitoring Plans for Negative Impact on Socio-economic Components

Environmental Components	Impact	Impact factor / activity	Environmental Management	Environmental Monitoring
(3) Socio-economic Components	1) People's unrest and conflict/opposition	Socialization of the project activities to local people	• Explanation of justification of the Project, benefits and impacts of the project as well as compensation to be given to project-affected people.	• Monitoring of people's unrest and the agreement / opposition for Project by questionnaire and/or interview survey before, during and after the Project.
	2) Impacts on income and livelihood of local people	Site clearance for land for project facility in cultivation area	• Socialization of the Project components, implementation schedule as well as compensation for negative impacts.	• Monitoring of livelihood change by questionnaire and/or interview surveys before, during and after the Project.
	3) Economic activities on downstream stretch (sand mining, inland navigation, water use of PDAM and irrigation and fishery)	ditto	• Socialization of schedule of sediment releasing and advance announcement of it when conducting sediment releasing. • Temporary closure of intake gates at the Colo weir during sediment releasing.	• Monitoring on impacts of sediment releasing on economic activities of downstream stretch of Bengawan Solo River by questionnaire and/or interview survey before and after sediment releasing. The target interviewee is as follows: • Sand mining: sand miner, • Inland navigation : boat operator, • Water use for PDAM : officials of PDAM, • Water use for irrigation : officials of PJT-I, • Fishery: Fisherman in Bengawan Solo River
	4) Impacts on local traffic and transportation	Increase of project-related vehicles for transportation of excavated materials	• Socialization of construction schedule of the Project, possible impacts, or inconvenience of traffic condition, • Education of drivers to be hired by the Project on driving manner and necessary care for local traffic. • Establishment of temporary stock yard and roads for transporting the excavated materials.	• Measurement of traffic volume at transportation route of excavated materials before and during the excavation works. • Monitoring on impacts (inconvenience of local traffic, traffic jam and accidents) by interview survey with villagers of nearest settlement area.
	5) Impact on traditional custom in Bengawan Solo River	Increase of discharge due to sediment releasing	• Socialization of schedule of sediment releasing and advance announcement of it when conducting sediment releasing.	• Monitoring on impacts of sediment releasing by interview survey with participants in "*Kungkum*," after sediment releasing
	6) Deterioration of sanitary condition	Wastewater and garbage from base camp as well as dust, noise and vibration	• Development of drainage system and garbage bins and its treatment at base camp of construction work, • Plus same management mentioned for management for dust, noise and vibration.	• Monitoring of impacts on sanitary and health problems by interview survey with the people living in the nearest settlement area from base camp and spillway construction site.
		Garbage release through new gate while sediment releasing	• Campaign for proper treatment of garbage to reduce dumping garbage into Keduang River.	• Monitoring of volume of garbage to reach to the new gate while sediment releasing.

Source: JICA Study Team

Table 7.5.2 Estimate of Construction Cost (1/3)

Item	Unit	Quantity	Unit cost	Amount
			($)	($, thousand)
[Summary]				
- Construction cost				54,914
- Contingencies				13,684
Total				**68,598**
[Breakdown 1]				
- Construction cost				
A. Sediment storage reservoir works and dredger procurement				
1. Sediment storage reservoir works				40,318
2. Procurement of dredger				3,579
Sub-total for A.				43,897
B. Watershed conservation works				
Sub-total for B.				11,017
Total of A.+B.				54,914
- Contingencies				
A. Sediment storage reservoir works and dredger procurement				
1. Sediment storage reservoir works				11,451
2. Procurement of dredger				404
Sub-total for A.				11,855
B. Watershed conservation works				
Sub-total for B.				1,829
Total of A.+B.				13,684
Total of Construction cost and Contingencies				**68,598**

Table 7.5.2 Estimate of Construction Cost (2/3)

[Breakdown 2 (1/2)]				
A. Sediment storage reservoir works and dredger procurement				
1. Sediment storage reservoir works				
1) Temporary works, 10% for 2)+3)+4)			10%	2,932
2) Spillway				
(1) Excavation	m^3	389,240	4	1,557
(2) Backfilling	m^3	134,970	2	270
(3) Concrete	m^3	93,320	113	10,545
(4) Reinforcing bar	t	4,666	982	4,582
(5) Radial gate	t	170	14,000	2,380
(6) Excavation, fore bay	m3	183,000	4	732
Sub-total for 2)				20,066
3) Closure dike				
(1) Steel sheet pile	t	4,450	1,326	5,901
(2) Filling, for dike	m^3	167,800	3	503
(3) Concrete	m^3	4,500	113	509
(4) Reinforcing bar	t	225	982	221
Sub-total for 3)				7,134
4) Overflow dike				
(1) Excavation	m^3	29,750	4	119
(2) Filling, for reservoir road	m^3	61,600	3	185
(3) Concrete	m^3	11,000	113	1,243
(4) Reinforcing bar	t	550	982	540
(5) Slide gate	t	5	7,000	35
Sub-total for 4)				2,122
5) Other works			25%	8,064
Total of 1) to 5)				40,318
6) Contingencies				
(1) Physical contingency			20%	8,064
(2) Price contingency			7%	3,387
Total for 6)				11,451
Total for 1.				**51,769**
2. Procurement of dredger				
1) Cutter suction dredger	unit	1	2,987,000	2,987
2) Anchor barge 3t D	unit	1	267,000	267
3) Other equipment			10%	325
Total of 1) to 3)				3,579
4) Contingencies				
(1) Physical contingency			5%	179
(2) Price contingency			6%	225
Total for 4)				404
Total for 2.				**3,983**
Total for A.				**55,752**

Table 7.5.2 Estimate of Construction Cost (3/3)

[Breakdown 2 (2/2)]				
B. Watershed conservation works				
1. Watershed conservation works				
1) Land preparation				
(1) Terracing				
/1 Cutting and filling	m^3	4,673,000	0.69	3,224
(2) Waterway and drop				
/1 Stone material	m^3	44,000	8.48	373
/2 Excavation	m^3	62,000	0.58	36
/3 Masonry work	m^3	40,000	10.64	426
(3) Lip and rizer, planting				
/1 Seedling, grass, for lip	nr.	83,858,000	0.0100	839
/2 Seedling, shrub, for lip	nr.	5,032,000	0.0700	352
/3 Seedling, grass, for riser	nr.	115,938,000	0.0015	174
/4 Planting work, for lip	m	25,158,000	0.01	252
/5 Planting work, for riser	m^2	23,188,000	0.02	464
2) Side ditches (housing yard)				
(1) Side ditch				
/1 Stone material	m^3	20,000	8.48	170
/2 Excavation	m^3	29,000	0.58	17
/3 Masonry work	m^3	18,000	10.64	192
(2) Hedge row				
/1 Shrub, for hedge row	nr.	4,467,000	0.07	313
/2 Planting work	m^2	558,000	0.02	11
3) Agro-forestry and annual crop				
(1) Agro-forestry and annual crop	L.S			3,075
4) Support program				
(1) Support program	L.S			1,099
Total of 1) to 4)				11,017
5) Contingencies				
(1) Physical contingency			10%	1,102
(2) Price contingency			6%	727
Total for 6)				1,829
Total for 1.				**12,846**
Total for B.				**12,846**

Source: JICA Study Team

Note:
- Price level: December 2006
  - Excange rate: $ 1.0= Y 118.92
  - Excange rate: $ 1.0= Rp. 9,050
  - Excange rate: Y 1.0= Rp. 76.1
- Costs are vlues before tax.

Table 7.5.3 Estimate of Consulting Service Cost (1/2)

Item		Amount
		($, thousand)
[Summary]		
1. Consulting service cost		5,491
2. Contingencies		1,428
Total		**6,919**
[Breakdown 1]		
A. Consulting for sediment storage reservoir works and dredger procurement		
1. Consulting service cost		4,118
2. Contingencies		1,071
Total for A.		5,189
B. Consulting for watershed conservation works		
1. Consulting service cost		1,373
2. Contingencies		357
Total for A.		1,730
Total of A. and B.		**6,919**
[Breakdown 2]		
Total consulting service cost is estimated below./*1		
1. Consulting service cost		
- Construction cost		54,914
1) Consulting service cost (10% of Construction cost)	10%	**5,491**
[Breakdown 3]		
Total consulting service cost is divided below./*2		
1. Consulting service cost		5,491
A. Consulting for sediment storage reservoir works and dredger procurement	75%	4,118
B. Consulting for watershed conservation works	25%	1,373
[Breakdown 4]		
A. Consulting for sediment storage reservoir works and dredger procurement		
1. Consulting service cost		4,118
2. Contingencies		
1) Physical contingency	20%	824
2) Price contingency	5%	247
Total for 2.		1,071
Total of 1. and 2.		5,189
B. Consulting for watershed conservation works		
1. Consulting service cost		1,373
2. Contingencies		
1) Physical contingency	20%	275
2) Price contingency	5%	82
Total for 2.		357
Total of 1. and 2.		1,730
Total of A. and B.		**6,919**

Table 7.5.3 Estimate of Consulting Service Cost (2/2)

[Breakdown 5]	
1. Consulting service cost	
A. Consulting for sediment storage reservoir works and dredger procurement	4,118
B. Consulting for watershed conservation works	1,373
Total for 1.	5,491
2. Contingencies	
A. Consulting for sediment storage reservoir works and dredger procurement	1,071
B. Consulting for watershed conservation works	357
Total for 2.	1,428
Total of 1. and 2.	**6,919**

Source: JICA Study Team

Note:
- Price level: December 2006
  - Excange rate: $ 1.0= Y 118.92
  - Excange rate: $ 1.0= Rp. 9,050
  - Excange rate: Y 1.0= Rp. 76.1
- Unit cost for land acquisition: $. 5.5 per square meter; converted from Rp. 50,000 per square meter
- Refer to Figure 3.3.1 for the price contingency.

*1: Consulting service cost (excluding contingencies) is estimated multiplying the construction cost (excluding contingencies) by the rate of the following.

10%

*2: Consulting service cost is divided into two categories in the proportion of the following.

75% for Item A. [Sediment storage reservoir works and equipment procurement]

25% for Item B. [Watershed conservation works]

Table 7.5.4 Estimate of Land Acquisition Cost

Item	Unit	Quantity	Unit cost	Amount
			($)	($, thousand)
1. Land acquition				
1) Land acquition	m^2	10,000	5.5	55
2) Compensation (Nil)	m^2	-	-	-
3) Resettlement (Nil)	m^2	-	-	-
Sub-total of 1) to 3)				55
4) Contingencies				
(1) Physical contingency			20%	11
(2) Price contingency			5%	3
Sub-total for 4)				14
Total for 1.				**69**

Source: JICA Study Team

Note: - Price level: December 2006
Excange rate: $ 1.0= Y 118.92
Excange rate: $ 1.0= Rp. 9,050
Excange rate: Y 1.0= Rp. 76.1
- Unit cost for land acquisition: $. 5.5 per square meter;
converted from Rp. 50,000 per square meter

Table 7.5.5 Estimate of Administrative Expenses (1/2)

Item		Amount
		($, thousand)
[Summary]		
1. Administrative expenses		549
2. Contingencies		142
Total		**691**
[Breakdown 1]		
A. Administration for sediment storage reservoir works and dredger procurement		
1. Administrative expenses		412
2. Contingencies		107
Total for A.		519
B. Administration for watershed conservation works		
1. Administrative expenses		137
2. Contingencies		35
Total for A.		172
Total of A. and B.		**691**
[Breakdown 2]		
Total consulting service cost is estimated below./*1		
1. Administrative expenses		
- Construction cost		54,914
1) Administrative expenses (1% of Construction cost)	1%	**549**
[Breakdown 3]		
Total consulting service cost is divided below./*2		
1. Administrative expenses		549
A. Administration for sediment storage reservoir works and dredger procurement	75%	412
B. Administration for watershed conservation works	25%	137
[Breakdown 4]		
A. Administration for sediment storage reservoir works and dredger procurement		
1. Administrative expenses		412
2. Contingencies		
1) Physical contingency	20%	82
2) Price contingency	5%	25
Total for 2.		107
Total of 1. and 2.		519
B. Administration for watershed conservation works		
1. Administrative expenses		137
2. Contingencies		
1) Physical contingency	20%	27
2) Price contingency	5%	8
Total for 2.		35
Total of 1. and 2.		172
Total of A. and B.		**691**

Table 7.5.5 Estimate of Administrative Expenses (2/2)

[Breakdown 5]	
1. Administrative expenses	
A. Administration for sediment storage reservoir works and dredger procurement	412
B. Administration for watershed conservation works	137
Total for 1.	549
2. Contingencies	
A. Administration for sediment storage reservoir works and dredger procurement	107
B. Administration for watershed conservation works	35
Total for 2.	142
Total of 1. and 2.	**691**

Source: JICA Study Team

Note:
- Price level: December 2006
  - Excange rate: $ 1.0= Y 118.92
  - Excange rate: $ 1.0= Rp. 9,050
  - Excange rate: Y 1.0= Rp. 76.1
- Unit cost for land acquisition: $. 5.5 per square meter; converted from Rp. 50,000 per square meter
- Refer to Figure 3.3.1 for the price contingency.

*1: Administrative expenses (excluding contingencies) is estimated multiplying the construction cost (excluding contingencies) by the rate of the following.

1%

*2: Administrative expenses is divided into two categories in the proportion of the following.

75% for Item A. [Sediment storage reservoir works and equipment procurement]

25% for Item B. [Watershed conservation works]

Table 7.5.6 Estimate of Project Cost

[Summary]

Item	Amount
	($, thousand)
I. Construction cost	54,914
II. Consulting service cost	5,491
III. Land acquition cost	69
IV. Administrative expenses	691
V. Contingencies	15,112
VI. Tax and duty (for I, II, & V)	7,552
Total of I. to VI.	**83,829**

[Breakdown 1: Cost by category]

Item			Amount
			($, thousand)
A. Sediment storage reservoir works and dredger procurement			
I. Construction works			43,897
II. Consulting service cost			4,118
III. Land acquition cost			69
IV. Administrative expenses			519
V. Contingencies			12,926
1. for Constrction works		(11,855)	
2. for Consulting services		(1,071)	
VI. Tax and duty (for I, II, & V)	10%		6,094
Sub-total for A.			67,623
B. Watershed conservation works			
I. Construction works			11,017
II. Consulting service cost			1,373
III. Land acquition cost			-
V. Administrative expenses			172
V. Contingencies			2,186
1. for Constrction works		(1,829)	
2. for Consulting services		(357)	
VI. Tax and duty (for I, II, & V)	10%		1,458
Sub-total for B.			16,206
Total of A.+B.			**83,829**

[Breakdown 2: Cost by funds]

Item	Amount under a foreign loan (Loan)	Amount under GOI budget (GOI)
	($, thousand)	($, thousand)
I. Construction cost	54,914	-
II. Consulting service cost	5,491	-
III. Land acquition cost	-	69
IV. Administrative expenses	-	691
V. Contingencies	15,112	-
VI. Tax and duty (for I, II, & V)	-	7,552
Total of I. to VI.	75,517	8,312
Total of Loan and GOI		**83,829**

Source: JICA Study Team

Note:
- Price level: December 2006
  - Excange rate: $ 1.0= Y 118.92
  - Excange rate: $ 1.0= Rp. 9,050
  - Excange rate: Y 1.0= Rp. 76.1
- Each of cost items includes physical and price contingencies.
- Item 'tax and duty' indicates value of VAT for Items I. and II.

Table 7.5.7 Estimate of Operation and Maintenance Cost

[A] Base data

Code	Item of works	Total cost	Breakdown: Earth-works	Concrete works	Metal works	Equip-ment
		($, tho.)	($, tho.)	($, tho.)	($, tho.)	($, tho.)
100	Sediment storage reservoir works	51,769	19,580	28,313	3,876	-
200	Procurement of dredger	3,983	-	-	-	3,983
300	Watershed conservation works	12,846	12,846	-	-	-

[B] Expected lifetime

Code	Item of works	Earth-works	Concrete works	Metal works	Equipment	
		(year)	(year)	(year)	(year)	
100	Sediment storage reservoir works	20	50	25	-	
200	Procurement of dredger	20	50	25	27	/*1
300	Watershed conservation works	2	50	25	-	

Note: *1: Value of 'Kensetsu Kikai-tou Sonryou-hyou, 2005' (Japan Construction Mechanization Association); 18 multiplied by 1.5.

[C] Maintenance and repair rate through life

Code	Item of works	Earth-works	Concrete works	Metal works	Equipment	
		(%)	(%)	(%)	(%)	
100	Sediment storage reservoir works	75	50	50	-	
200	Procurement of dredger	75	50	50	100	/*1
300	Watershed conservation works	75	50	50	-	

Note: *1: Value of 'Kensetsu Kikai-tou Sonryou-hyou, 2005' (Japan Construction Mechanization Association); 135% multiplied by 0.75.

[D] Maintenance and repair rate cost (per annum)

Code	Item of works	Mainte., total	Earth-works	Concrete works	Metal works	Equipment
		($, tho.)	($, tho.)	($, tho.)	($, tho.)	($, tho.)
100	Sediment storage reservoir works	1,095	734	283	78	-
200	Procurement of dredger	148	-	-	-	148
300	Watershed conservation works	4,817	4,817	-	-	-

Note: - [D]= [A] / [B] x [C]/100

[E] Operation cost (energy consumption, per annum)

Code	Item of equipment	Rated power	Fuel consump.	Yearly ope. hr/*4	Yearly consump.	Operation cost/*1	
		(kW)	(L/kW/hr)	(hr)	(L)	($)	
100	Sediment storage reservoir works						
	(fore bay)						
	Bulldozer, 4t, swamp	34	0.175	3,846	22,884	12,100	/*2
	Crawler loader, 2.3m3	151	0.175	14	370	200	/*2
	Dump truck, 10t (hauling= 1km)	246	0.050	67	824	400	/*2
				Sub-total for 100		12,700	
200	Procurement of dredger						
	(in front of intake, by cutter-suction dredger)						
	Cutter-suction dredger, 600PS	441	0.381	917	154,075	59,300	/*3
	(in front of intake, by syphon dredger)						
	Generator, 10kVA (for siphon pump and agitator)	13	0.170	-	-	-	/*2
				Sub-total for 200		59,300	
300	Watershed conservation works						
	(Nil)	-	-	-	-	-	

Note: *1: The rate of 10% is added to the amount for lubricant and others.

	Fuel	Price (Rp./L)	Exch. rate (Rp./$)	Price ($/L)
*2:	Light oil (diesel)	4,300	9,050	0.48
*3:	Heavy oil	3,142	9,050	0.35

*4: computed below;

Code	Equipment	Hourly production	Yearly work q'ty	Yearly ope. hr
100	Sediment storage reservoir works			
	(fore bay)			
	Bulldozer, 4t, swamp	3	10,000	3,846
	Crawler loader, 2.3m3	70	1,000	14
	Dump truck, 10t (hauling= 1km)	15	1,000	67
200	Procurement of dredger			
	(in front of intake, by cutter-suction dredger)			
	Cutter-suction dredger, 600PS	109	100,000	917
	(in front of intake, by syphon dredger)			
	Generator, 10kVA (for siphon pump and agitator)	546	-	-
300	Watershed conservation works			
	(Nil)	(Nil)	(Nil)	(Nil)

[F] Operation and maintenance cost (per annum)

Code	Item of works	Operation cost	Maintenance cost	Total O&M cost	Yearly production	O&M cost per m3	
		($)	($)	($)	(m3)	($)	
100	Sediment storage reservoir works	12,700	1,095	**13,795**	300,000	0.046	/*1
200	Procurement of dredger	59,300	148	**59,448**	100,000	0.594	/*1
300	Watershed conservation works	-	4,817	**4,817**	470,000	0.010	/*2

Note: - [F]= [D] + [E]

*1: for 'yearly production', Quantity of sediment to be evacuated

*2: for 'yearly production', Quantity of deductive sediment to be deposited (8,067,000t x 18.6% /1.064= 1,410,000m3)

Source: JICA Study Team

Table 8.2.1 Economic Cost of Urgent Countermeasures

(Unit:US$ thousand)

Countermeasures	Project Cost (excluding land aquisition cost and , Tax and duty) / Financial	Total Cost / Economic	Conversion Factor
1. Urgent Countermeasures for Garbage and Sediment Inflow from Keduang River			
a. Sediment Storage Reservoir with New Gates	57,881	41,096	0.71
b. Watershed Conservation in Keduang Catchment	14,748	12,778	(Total works both by government and beneficiary) x CF
c. Procurement of One Dredger	3,579	3,579	1.00
Total	**76,208**	**57,453**	

(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
Total	**78**	**62**	

Source: JICA Study Team

Table 8.2.2 Economic Project Cost of the Watershed Conservation in Keduang Catchment

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	4,673	0.92	0.75	0.69	3,224
2) Waterway and drop						
(1) stone material	m^3	44	8.48	0.90	7.632	336
(2) Excavation work	m^3	62	0.78	0.75	0.585	36
(3) Masonry work	m^3	40	14.23	0.75	10.6725	427
3) Lip and rizer, planting						
(1) Seedling, grass for lip	nr.	83,858	0.01	0.90	0.009	755
(2) Seedling, shrub for lip	nr.	5,032	0.07	0.90	0.063	317
(3) Seedling, grass, for rizer	nr.	115,938	0.0015	0.90	0.00135	157
(4) Planting work, for lip	m	25,258	0.02	0.75	0.012	303
(5) Planting work, for rizer	m^2	23,188	0.04	0.75	0.03	696
2. Side diches (for housing yard)						
1) Side ditch						
(1) Stone material	m^3	20	8.48	0.90	7.632	153
(2) Excavation work	m^3	29	0.78	0.75	0.585	17
(3) Masonry work	m^3	18	14.23	0.75	10.6725	192
2) Headgerow						
(1) Shrub, for hedger row	nr.	4,467	0.07	0.90	0.063	281
(2) planting work, hedge row	m^2	558	0.04	0.75	0.03	17
3. Agro-forestry and annual crops						
1) Agro-forestry and annual crops	Ls		3075.00	0.90		2,768
4. Support program						
1) Support program	Ls		1099.00	0.90		989
Total Direct Cost						**10,667**
(II) Government Admnistration and Engineering cost						
(11% of total direct cost)				0.90		1,056
(II) Pysical Contingency						
(10% of total cost of I andII)				0.90		1,055
Total Economic Cost						**12,778**

*: Conversion factor of unskilled labor: 0.75, Standard conversion factor for materials:0.9

Source: JICA study team

Table 8.3.1 Total Economic Benefit from Keduang Watershed Conservation Project (1/3)

development year					Slope of Class					Total
					0-8%	8-15%	15-25%	25-40%	over 40%	
1st year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.01	2.70	2.01	1.05	0.20	
			Net retun	(Rp million)	4,495	7,041	3,825	1,169	287	16,817
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	2,724
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				648	231	-1,183	-1,013	-2,551	**-3,868**
2nd year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.06	2.84	2.27	1.42	0.73	
			Net retun	(Rp million)	4,570	7,406	4,319	1,581	1,047	18,923
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	21,648
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				723	596	-689	-601	-1,791	**-1,761**
3rd yea	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.05	2.81	2.22	1.34	0.62	
			Net retun	(Rp million)	4,555	7,328	4,224	1,491	890	18,488
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	21,213
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				708	518	-784	-690	-1,949	**-2,197**
4th yeara	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.15	3.08	2.73	2.12	1.65	
			Net retun	(Rp million)	4,705	8,032	5,195	2,360	2,367	22,658
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	25,382
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				857	1,222	187	178	-471	**1,973**
5th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.09	2.88	2.75	2.52	2.60	
			Net retun	(Rp million)	4,615	7,510	5,233	2,805	3,730	23,893
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	26,618
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				768	700	225	624	892	**3,208**
6th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.18	3.10	3.18	3.17	3.46	
			Net retun	(Rp million)	4,749	8,084	6,051	3,528	4,964	27,377
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	30,101
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				902	1,274	1,043	1,347	2,126	**6,692**

Table 8.3.1 Total Economic Benefit from Keduang Watershed Conservation Project (2/3)

7th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.24	3.27	3.51	3.67	4.11	
			Net retun	(Rp million)	4,839	8,527	6,679	4,085	5,897	30,027
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	32,751
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				992	1,717	1,671	1,904	3,059	**9,342**
8th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.30	3.42	3.50	3.81	4.09	
			Net retun	(Rp million)	4,929	8,918	6,660	4,241	5,868	30,616
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	33,340
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,081	2,109	1,652	2,059	3,030	**9,931**
9th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.36	3.58	4.10	4.57	5.30	
			Net retun	(Rp million)	5,018	9,336	7,802	5,087	7,604	34,846
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	37,571
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,171	2,526	2,793	2,905	4,766	**14,161**
10th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.42	3.72	4.37	4.98	5.84	
			Net retun	(Rp million)	5,108	9,701	8,315	5,543	8,379	37,046
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	39,770
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,261	2,891	3,307	3,362	5,541	**16,361**
11th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.47	3.87	4.36	5.11	5.81	
			Net retun	(Rp million)	5,183	10,092	8,296	5,688	8,336	37,594
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	40,319
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,335	3,282	3,288	3,506	5,498	**16,909**
12th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.48	3.89	4.69	5.47	6.48	
			Net retun	(Rp million)	5,197	10,144	8,924	6,088	9,297	39,651
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	42,376
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,350	3,334	3,916	3,907	6,459	**18,966**

Table 8.3.1 Total Economic Benefit from Keduang Watershed Conservation Project (3/3)

13th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.50	3.93	4.78	5.60	6.65	
			Net retun	(Rp million)	5,227	10,248	9,095	6,233	9,541	40,345
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	43,070
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,380	3,438	4,087	4,052	6,703	**19,660**
14th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.51	3.97	4.85	5.71	6.80	
			Net retun	(Rp million)	5,242	10,353	9,229	6,355	9,756	40,935
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	43,660
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,395	3,543	4,221	4,174	6,918	**20,251**
15th year	with project condition	Terrace	Gross area	(ha)	1,524	2,804	2,138	1,341	1,913	9,720
			Net area	(ha)	1,494	2,608	1,903	1,113	1,435	9,526
			Net return/ha	(Rp million)	3.51	3.97	4.85	5.71	6.80	
			Net retun	(Rp million)	5,242	10,353	9,229	6,355	9,756	40,935
	Without project condition	Composite	Gross area	(ha)	762	897	556	241	268	2,724
			Net area	(ha)	762	897	556	241	268	43,660
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,943	2,288	1,417	456	506	6,611
		Terrace	Gross area	(ha)	762	1,907	1,582	1,100	1,645	6,996
			Net area	(ha)	747	1,773	1,408	913	1,234	13,607
			Net return/ha	(Rp million)	2.55	2.55	2.55	1.89	1.89	
			Net retun	(Rp million)	1,904	4,522	3,591	1,725	2,332	14,074
	Benefit				1,395	3,543	4,221	4,174	6,918	**20,251**

Source: JICA Study Team

Sloope Class (%)	rate of netarea/gross area in planning	sharing rate of uplands by composite and terrace (%) at present condition		upland areas in Keduang watershed
		composite	terrace	(ha)
0-8	0.98	50	50	1,524
8-15	0.93	32	68	2,804
15-25	0.89	26	74	2,138
25-40	0.83	18	82	1,341
over 40	0.75	14	86	1,913
Total				9,720

remark: rate of net area/gross area is applied to 100% for composite lands and plannng rate to terrace lands

Table 8.4.1 Net Present Value and Economic Internal Rate of Return for Urgent Countermeasures

NPV	56.2 **USD Million**
EIRR	16.9%

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	**-24.052**	0.000	0.000	-0.385	**-0.385**	13.699	6.389	3.579	-	0.000	0.000	0.000	-	**23.667**
2	2011	**-20.290**	0.002	0.017	-0.175	**-0.156**	13.699	6.389	0.000	-	0.000	0.000	0.047	-	**20.135**
3	2012	**-13.929**	0.005	0.035	-0.219	**-0.179**	13.699	0.000	0.000	-	0.000	0.004	0.047	-	**13.750**
4	2013	**-1.300**	0.010	0.076	-1.323	**-1.237**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
5	2014	**-0.783**	0.018	0.129	-0.867	**-0.721**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
6	2015	**-0.249**	0.026	0.195	-0.408	**-0.187**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
7	2016	**1.221**	0.037	0.273	0.974	**1.284**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
8	2017	**1.847**	0.050	0.363	1.496	**1.909**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
9	2018	**3.305**	0.062	0.454	2.851	**3.367**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
10	2019	**4.339**	0.074	0.545	3.782	**4.401**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
11	2020	**4.615**	0.087	0.636	3.955	**4.678**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
12	2021	**6.095**	0.099	0.726	5.332	**6.158**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
13	2022	**6.856**	0.111	0.817	5.990	**6.918**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
14	2023	**51.214**	5.409	39.710	6.158	**51.277**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
15	2024	**51.736**	5.401	39.650	6.747	**51.798**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
16	2025	**51.854**	5.393	39.590	6.934	**51.917**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
17	2026	**51.945**	5.385	39.531	7.092	**52.008**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
18	2027	**51.877**	5.377	39.471	7.092	**51.940**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
19	2028	**51.809**	5.369	39.411	7.092	**51.872**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
20	2029	**51.742**	5.360	39.351	7.092	**51.804**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
21	2030	**51.674**	5.352	39.292	7.092	**51.736**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
22	2031	**51.606**	5.344	39.232	7.092	**51.668**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
23	2032	**51.538**	5.336	39.172	7.092	**51.600**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
24	2033	**51.470**	5.328	39.112	7.092	**51.532**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
25	2034	**51.402**	5.320	39.052	7.092	**51.464**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
26	2035	**51.334**	5.312	38.993	7.092	**51.397**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
27	2036	**51.266**	5.303	38.933	7.092	**51.329**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
28	2037	**51.198**	5.295	38.873	7.092	**51.261**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
29	2038	**51.130**	5.287	38.813	7.092	**51.193**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
30	2039	**51.062**	5.279	38.754	7.092	**51.125**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
31	2040	**50.995**	5.271	38.694	7.092	**51.057**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
32	2041	**50.927**	5.263	38.634	7.092	**50.989**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
33	2042	**50.859**	5.255	38.574	7.092	**50.921**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
34	2043	**50.791**	5.246	38.515	7.092	**50.853**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
35	2044	**50.723**	5.238	38.455	7.092	**50.785**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
36	2045	**50.655**	5.230	38.395	7.092	**50.717**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
37	2046	**50.587**	5.222	38.335	7.092	**50.650**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
38	2047	**50.519**	5.214	38.275	7.092	**50.582**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
39	2048	**50.451**	5.206	38.216	7.092	**50.514**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
40	2049	**50.383**	5.198	38.156	7.092	**50.446**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
41	2050	**50.315**	5.189	38.096	7.092	**50.378**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
42	2051	**50.248**	5.181	38.036	7.092	**50.310**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
43	2052	**50.180**	5.173	37.977	7.092	**50.242**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
44	2053	**50.112**	5.165	37.917	7.092	**50.174**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
45	2054	**50.044**	5.157	37.857	7.092	**50.106**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
46	2055	**49.976**	5.149	37.797	7.092	**50.038**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
47	2056	**49.908**	5.141	37.738	7.092	**49.970**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
48	2057	**49.840**	5.132	37.678	7.092	**49.903**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
49	2058	**49.772**	5.124	37.618	7.092	**49.835**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**
50	2059	**49.704**	5.116	37.558	7.092	**49.767**	0.000	0.000	0.000	-	0.011	0.004	0.047	-	**0.062**

Source: JICA Study Team